Doosan Infracore

DX190W

Serial Number 5001 thru 5408

Shop Manual

K1024513E-1

UNAUTHORIZED MODIFICATIONS

Any modification made without authorization or written approval from *DOOSAN* can create a safety hazard, for which the machine owner must be held responsible.

For safety's sake, replace all OEM parts with the correct authorized or genuine *DOOSAN* part. For example, not taking the time to replace fasteners, bolts or nuts with the correct replacement parts could lead to a condition in which the safety of critical assemblies is dangerously compromised.

GENERAL HAZARD INFORMATION

Safety Rules

Only trained and authorized personnel can operate and maintain the machine.

Follow all safety rules, precautions and instructions when operating or performing maintenance on the machine.

Do not operate the machine if you are not feeling well, if you are taking medication that makes you feel sleepy, if you have been drinking, or if you are suffering from emotional problems. These problems will interfere with your sense of judgement in emergencies and may cause accidents.

When working with another operator or with a person on work site traffic duty, be sure that all personnel know the nature of the work and understand all hand signals that are to be used.

Always observe strictly any other rules related to safety.

Safety Features

Be sure that all guards and covers are installed in their proper position. Have guards and covers repaired immediately if damaged.

Be sure that you understand the method of use of safety features such as safety lock lever and the seat belt, and use them properly.

Never remove any safety features. Always keep them in good operating condition.

Failure to use safety features according to the instructions in the Operation and Maintenance Manual could result in serious bodily injury.

Engine Starting

Walk around your machine before getting in the operator's cabin. Look for evidence of leaking fluid, loose fasteners, misaligned assemblies or any other indications of possible equipment hazard.

All equipment covers and machinery safety guards must be in place, to protect against injury while the machine is being operated.

Look around the work site area for potential hazards, people or properly that could be at risk while operation is in progress.

NEVER start the engine if there is any indication that maintenance or service work is in progress, or if a warning tag is attached to controls in the cabin.

A machine that has not been used recently, or is being operated in extremely cold temperatures, could require a warm-up or maintenance service before start-up.

Check gauges and monitor displays for normal operation before starting the engine. Listen for unusual noises and remain alert for other potentially hazardous conditions at the start of the work cycle.

Do not short circuit the starting motor to start the engine. This is not only dangerous, but may also damage the machine.

When starting the engine, sound the horn as an alert.

Start and operate the machine only while seated.

When carrying out welding repairs, carry out the welding in a properly equipped place. The welding should be performed by a qualified worker. During welding operations, there is the danger of, generation of gas, fire, or electric shock, so never let an unqualified worker do welding.

The qualified welder must do the following;

- To prevent explosion of the battery, disconnect the battery terminals and remove batteries.
- To prevent generation of gas, remove the paint from the location of the weld.
- If hydraulic equipment, piping or places close to them are heated, a flammable gas or mist will be generated and there is danger of it catching fire. To avoid this, never subject these places to heat.
- Do not weld on pipes or on tubes that contain flammable fluids. Do not flame cut on pipes or on tubes that contain flammable fluids. Before you weld on pipes or on tubes or before you flame cut on pipes or on tubes, clean the pipes or tubes thoroughly with a nonflammable solvent.
- If heat is applied directly to rubber hoses or piping under pressure, they may suddenly break so cover them with a fireproof covering.
- Wear protective clothing.
- Make sure there is good ventilation.
- Remove all flammable objects and provide a fire extinguisher.

Treatment for Electrical Welding to the Body Structure

To prevent damage to ECU by electrical welding, please observe the following procedures:

1. Open the door of the battery cover.
2. Detach the cover after loosening the bolts on the battery.
3. Detach the positive and negative terminal cables from the battery.
4. Detach the undercover, and after that detach the connector (1) from the ECU that are installed at the engine.
5. Proceed with welding.

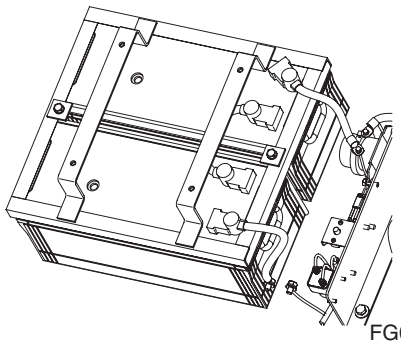

Figure 35

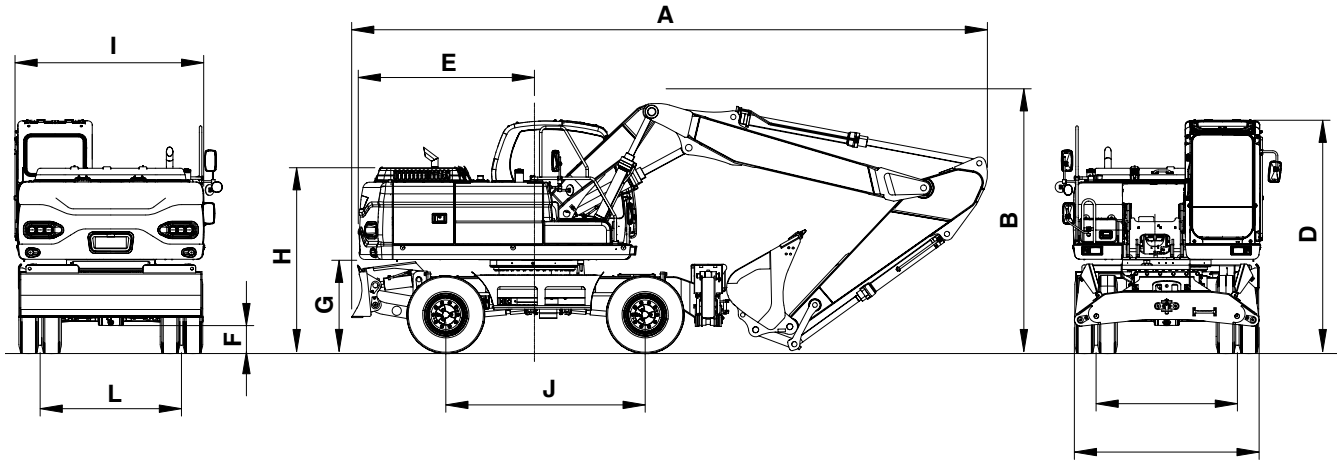

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Figure 3

Referance	Description	Dimension			
		5.36 m (17' 7") Two-Piece Boom			
		2.3 m (7' 7") Arm		2.6 m (8' 6") Arm	
A	Shipping Length	8,860 mm	29' 1"	8,610 mm	28' 3"
B	Shipping Width	2,496 mm	8' 2"	2,496 mm	8' 2"
C	Shipping Height (Boom)	3,140 mm	10' 4"	3,360 mm	11'
D	Height Over Cab	3,135 mm	10' 3"	3,135 mm	10' 3"
E	Counter Weight Swing Clearance	2,450 mm	8'	2,450 mm	8'
F	Ground Clearance	350 mm	1' 1"	350 mm	1' 1"
G	CounterWeight Clearance	1,249 mm	4' 1"	1,249 mm	4' 1"
H	Engine Cover Height	2,530 mm	8' 3"	2,530 mm	8' 3"
I	Upper Housing Width	2,494 mm	8' 2"	2,494 mm	8' 2"
J	Wheel Base	2,700 mm	8' 10"	2,700 mm	8' 10"
K,L	Tread Width	1,944 mm	6' 5"	1,944 mm	6' 5"

ENGINE PERFORMANCE CURVES (PER DIN 6271 STANDARD)

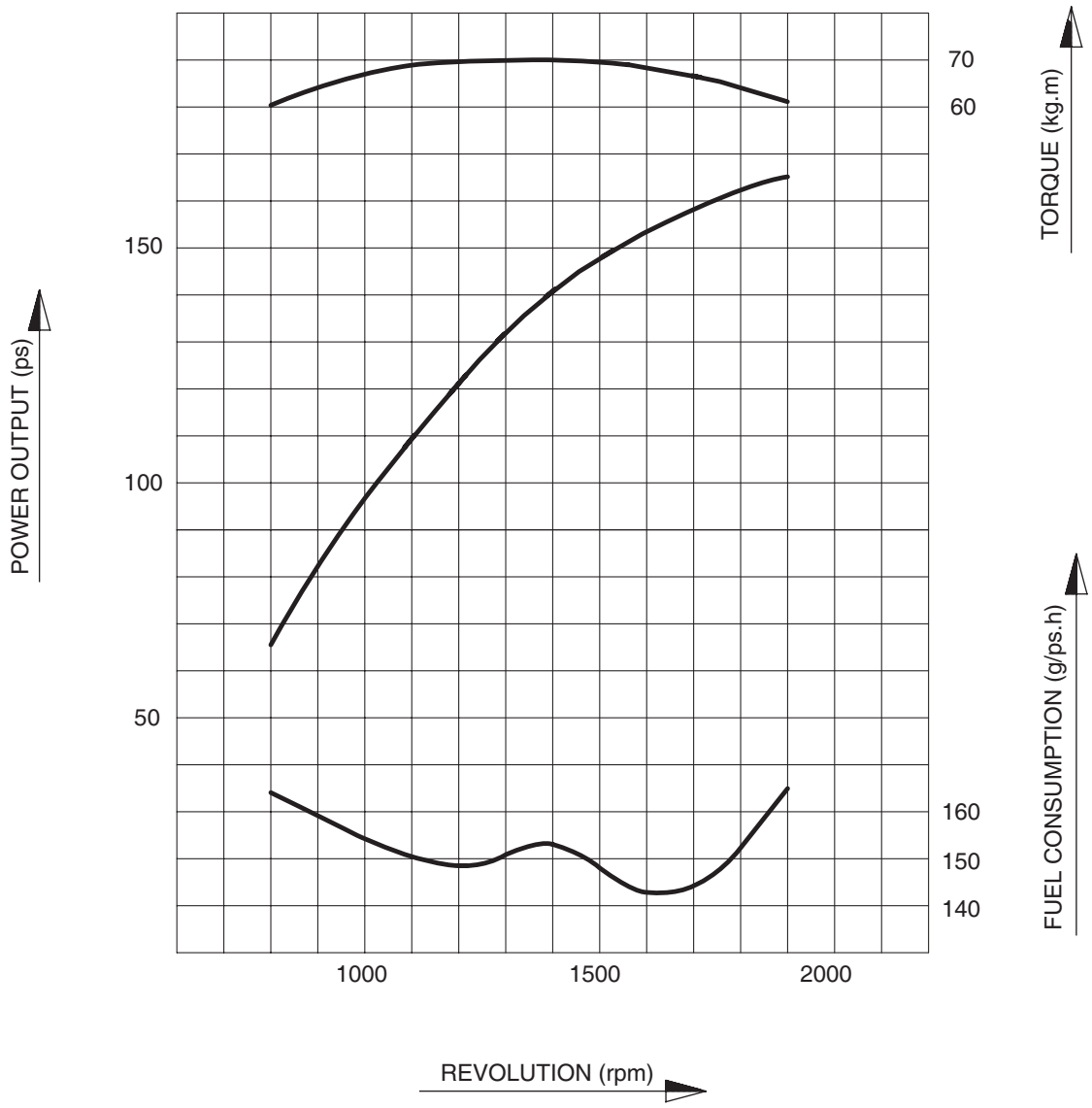

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Figure 8

General Maintenance

MAINTENANCE SERVICE AND REPAIR PROCEDURE

General Precautions

Fluid level and condition should always be checked whenever any other type of maintenance service or repair is being performed.

NOTE: *If the unit is being used in an extreme temperature environment (in sub-freezing climates or in high temperature, high humidity tropical conditions), frequent purging of moisture condensation from the hydraulic reservoir drain tap should be a regular and frequent part of the operating routine. In more moderate, temperate climates, draining reservoir sediment and moisture may not be required more than once or twice every few months.*

Inspect drained oil and used filters for signs of abnormal coloring or visible fluid contamination at every oil change. Abrasive grit or dust particles will cause discoloration and darkening of the fluid. Visible accumulations of dirt or grit could be an indication that filter elements are overloaded (and will require more frequent replacement) or that disintegrating bearings or other component failures in the hydraulic circuit may be imminent or have already occurred. Open the drain plugs on the main pump casings and check and compare drain oil in the pumps. Look for evidence of grit or metallic particles.

Vibration or unusual noise during operation could be an indication of air leaking into the circuit (Refer to the appropriate Troubleshooting section for component or unit for procedures.), or it may be evidence of a defective pump. The gear type pilot pump could be defective, causing low pilot pressure, or a main pump broken shoe or piston could be responsible.

NOTE: *If equipped, indicated operating pressure, as shown on the multidisplay digital gauge on the Instrument Panel ("F-Pump" and "R-Pump") will be reduced as a result of a mechanical problem inside the pump. However, pressure loss could also be due to cavitation or air leakage, or other faults in the hydraulic system.*

Check the exterior case drain oil in the main pumps. If no metallic particles are found, make sure there is no air in the system. Unbolt and remove the tank return drain line from the top part of the swing motor, both travel motors and each main pump. If there is air in any one of the drain lines, carefully prefill the assembly before bolting together the drain line piping connections. Run the system at low rpm.

Standard Torques

Edition 1

TORQUE VALUES FOR SPLIT FLANGES

The following chart provides the tightening torques for split flange connections used in hydraulic systems. Split flanges and fitting shoulders should fit squarely. Install all bolts, finger tight and then torque evenly.

NOTE: *Over torquing bolts will damage the flanges and/or bolts, which may cause leakage.*

Flange Size (*)	Bolt Size	Bolt Torque	
		Kilogram Meter (kg•m)	Foot Pounds (ft lb)
1/2"	5/16"	2.1 - 2.5	15 - 18
3/4"	3/8"	3.0 - 3.7	22 - 27
1"	3/8"	3.7 - 4.8	27 - 35
1 - 1/4"	7/16"	4.8 - 6.2	35 - 45
1 - 1/2"	1/2"	6.4 - 8.0	46 - 58
2"	1/2"	7.6 - 9.0	55 - 65
2 - 1/2"	1/2"	10.9 - 12.6	79 - 91
3"	5/8"	19.1 - 20.7	138 - 150
3 - 1/2"	5/8"	16.2 - 18.4	117 - 133

(*) - Inside diameter of flange on end of hydraulic tube or hose fitting.

NOTE: *Values stated in chart are for Standard Pressure Series (Code 61) Split Flanges.*

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Cabin

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Fuel Tank

10. Connect as tagged, fuel supply line (21, Figure 20) and fuel return line (19) to fuel tank (1).
11. Install clamp (20, Figure 20) to hold fuel return line (19) to tank (1).

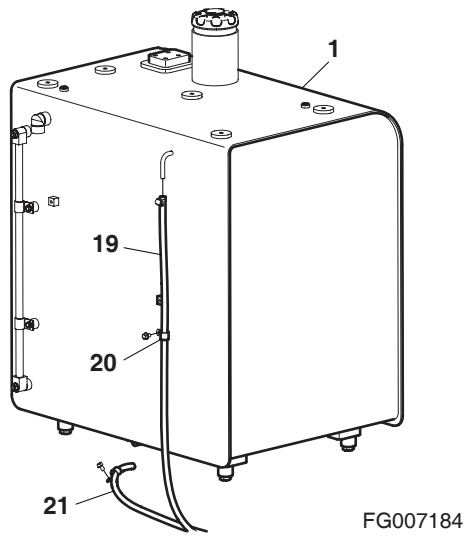

Figure 20

12. Make sure fuel tank drain valve (6, Figure 21) on bottom of tank is closed.
13. Fill fuel tank and check for signs of leaks. Correct any problems found.
14. Connect negative (-) battery cable to battery.

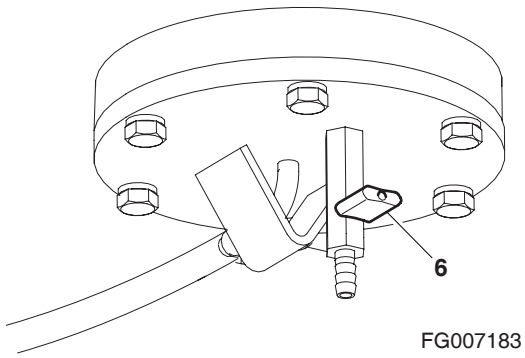

Figure 21

Insert vane, with the circled edge of vane facing in the counterclockwise direction. (Detail A)

Insert a new O-ring during reassembly of pump cover.

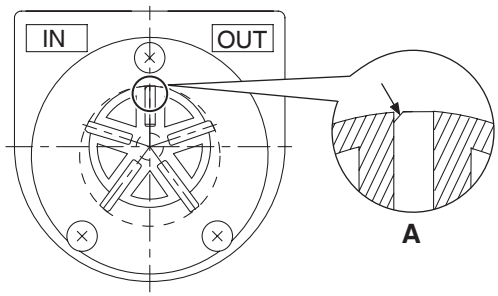

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Figure 6

REPLACEMENT OF REAR COVER

Brush assembly and a thermal limiter are installed in the rear cover. If you find any damage, replace them with new ones.

Remove the switch cover and screw (M5 x L95) from the rear cover.

Remove cover.

At reassembly of rear cover, widen the space of the brush and insert it to the armature. Then fit the hole of screw in the housing.

Be careful when installing the screw. The cover screw may be attracted by the motor magnet.

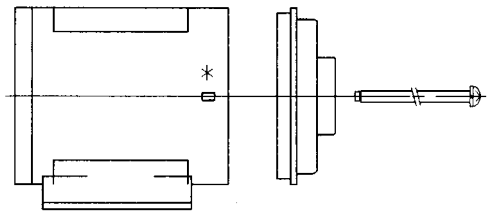

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Figure 7

REPLACEMENT OF ARMATURE

You can replace only the armature in case motor was damaged by a short circuit.

Remove the switch cover and rear cover, than remove the armature from the housing.

Remove the pump cover and remove the rotor and vane.

Insert a new armature into the housing.

Refer to “Replacement of Rear Cover” on page 1-9, for installation of the rear cover.

Fit the rotor into the shaft flute of the armature. Insert vane to the rotor being careful of the direction. Refer to “Replacement of Rotor and Vane” on page 1-8.

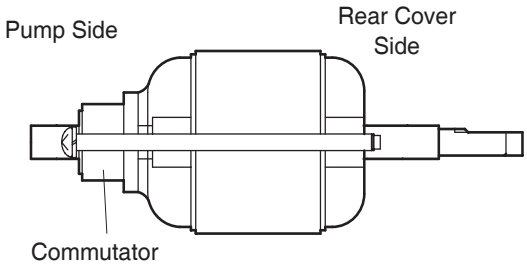

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Figure 8

REMOVAL

1. Park on firm and level ground.
2. Lower front attachment (bucket) to ground.
3. Shut down engine.
4. Set safety lever on "RELEASED" position.
5. Turn starter switch to "I" (ON) position.

⚠ WARNING!

If engine must be running while performing maintenance, always use extreme caution. Always have one person in cab at all times. Never leave cab with engine running.

6. Fully stroke work levers (joysticks) in all directions to relieve any pressure from accumulators.
7. Set safety lever on "LOCK" position.
8. Turn key to "O" (OFF) position and remove from starter switch.
9. Hang a maintenance warning tag on controls.
10. Disconnect negative (-) battery cable leading to frame from battery.
11. Tag and disconnect hoses from swing motor (1, Figure 3). Plug and cap hoses and ports to prevent contamination from entering hydraulic system or component.
12. Assemble drain hose (3, Figure 3) to drain valve (8) and drain oil from reduction gearbox (5, Figure 3).
13. Remove drain hose (3, Figure 3) from drain valve (8) and disconnect hose (2, Figure 3) from reduction gearbox (5).
14. Disconnect grease lubrication line (7, Figure 3) from reduction gearbox (5).
15. Remove eleven bolts and washers (4, Figure 3) holding swing reduction gearbox (5) to frame.
16. Using a suitable lifting device, sling swing motor (1, Figure 3) and remove swing motor and reduction gearbox (5) as an assembly from unit.

NOTE: *There is a alignment pin (6*, Figure 3*), on reduction gearbox flange.*

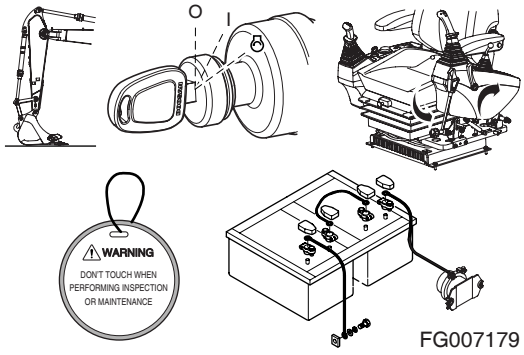

Figure 2

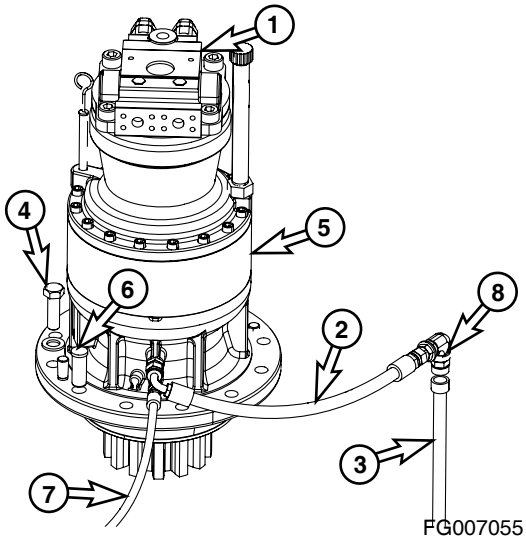

Figure 3

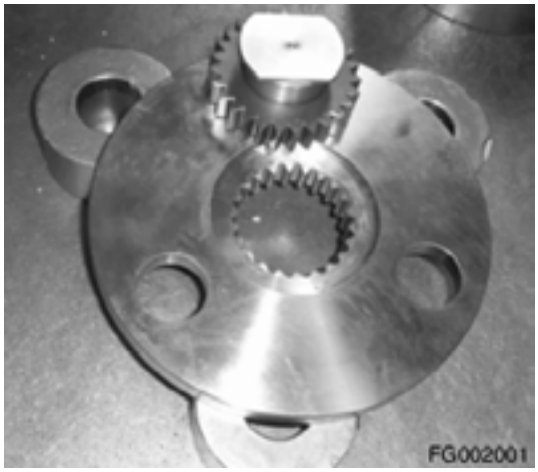

Figure 33

3. Put the jig, while keeping the pin assembly 1 perpendicular, and push it with a press.
4. After its pressure insert, check the state of the pressure insert visually.

Figure 34

5. Insert the 2 remaining parts with pressure in the same way.

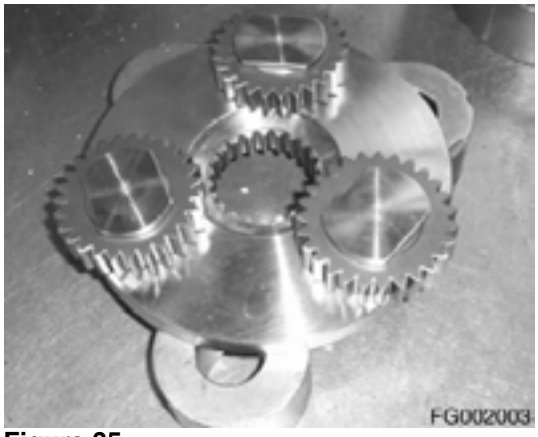

Figure 35

Assembly of Ring Gear

1. Insertion of lock pin.

   Insert four lock pins in four reamed holes of case flange. Tap them into place, by gently hitting them with a soft-face hammer.

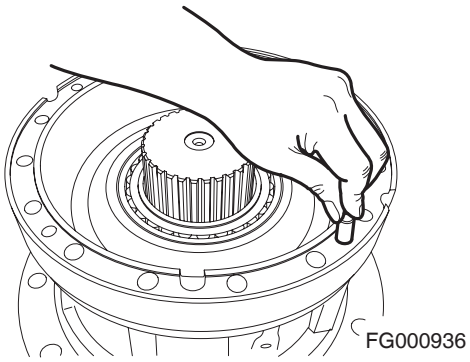

Figure 75

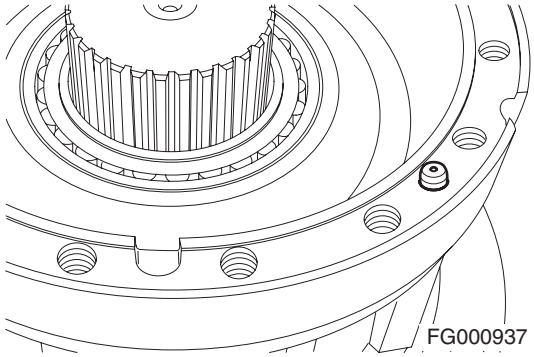

Figure 76

2. Apply liquid gasket (Three Bond #1104) evenly to ring gear assembly of casing.

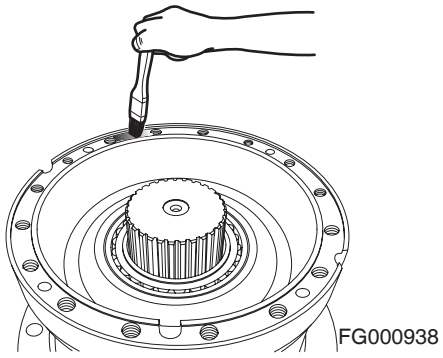

Figure 77

3. Lift ring gear with hoist, wipe its mating surface clean with cloth, match and align holes after checking its assembling direction, and press assembled parts firmly by tightening special bolts (M12x150) on which no Loctite has been applied.

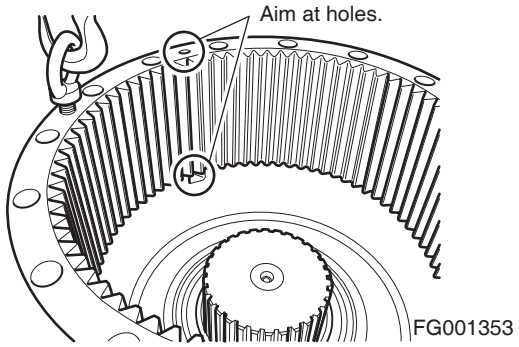

Figure 78

Assembly and Disassembly of Chocking Valve

1. Assemble the main poppet, the pilot poppet, the spring and the spring seat in order. Insert the sub-assembly to the block and fasten the hexa-head plug.

   Hexa-head (41 mm) plug fastening torque : 7.0 kg•m

Figure 3

2. Insert each of the two plungers to each of the holes of the block.

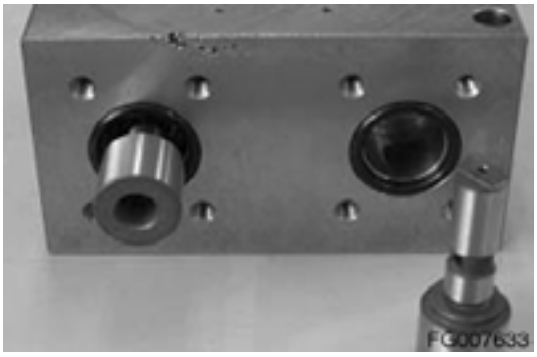

Figure 4

3. Mount the O-rings to the block and fasten the plate with bolts.

   A. O-ring: 1B-P24

   B. Wrench bolt (5 mm) fastening torque : 1.2 kg•m

Figure 5

NOTE: *Follow the reverse procedure for disassembly.*

2. Assemble the spool ass'y to the body.

   A. Insert the assembly to the hole of the C port direction.

   B. Insert the spool ass'y to the spool hole of the body precisely and be careful not to allow intrusion of foreign material. Do not apply excessive force for assembly.

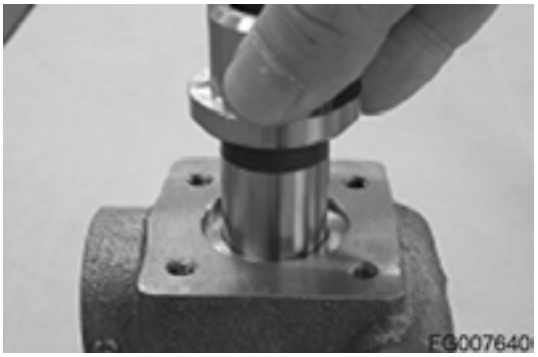

Figure 5

3. Assemble the return spring #1 and #2 to the body, insert the O-ring into the cover #1 and fasten the cover to the body with bolts.

   A. Fastening O-RING: 1B-P41

   B. Bolt Fastening Torque : 0.8 kg•m - 1.2 kg•m

Figure 6

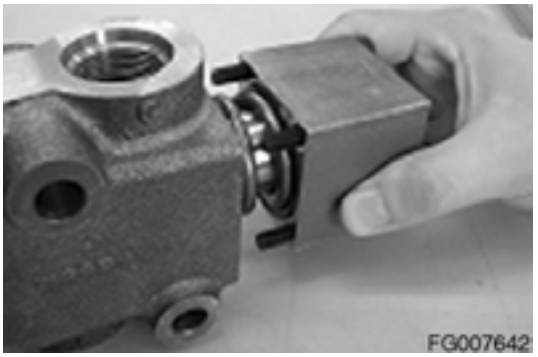

Figure 7

4. Insert the O-ring into the cover #2 for the opposite side and fasten the cover #2 to the body with bolts.

   A. Bolt Fastening Torque : 0.8 kg•m - 1.2 kg•m

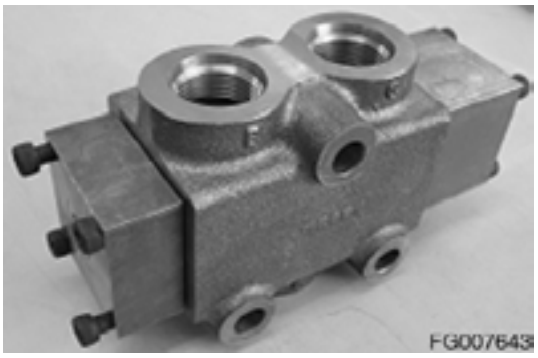

Figure 8

NOTE: *Follow the reverse procedure for disassembly.*

OPERATIONAL PRINCIPLE

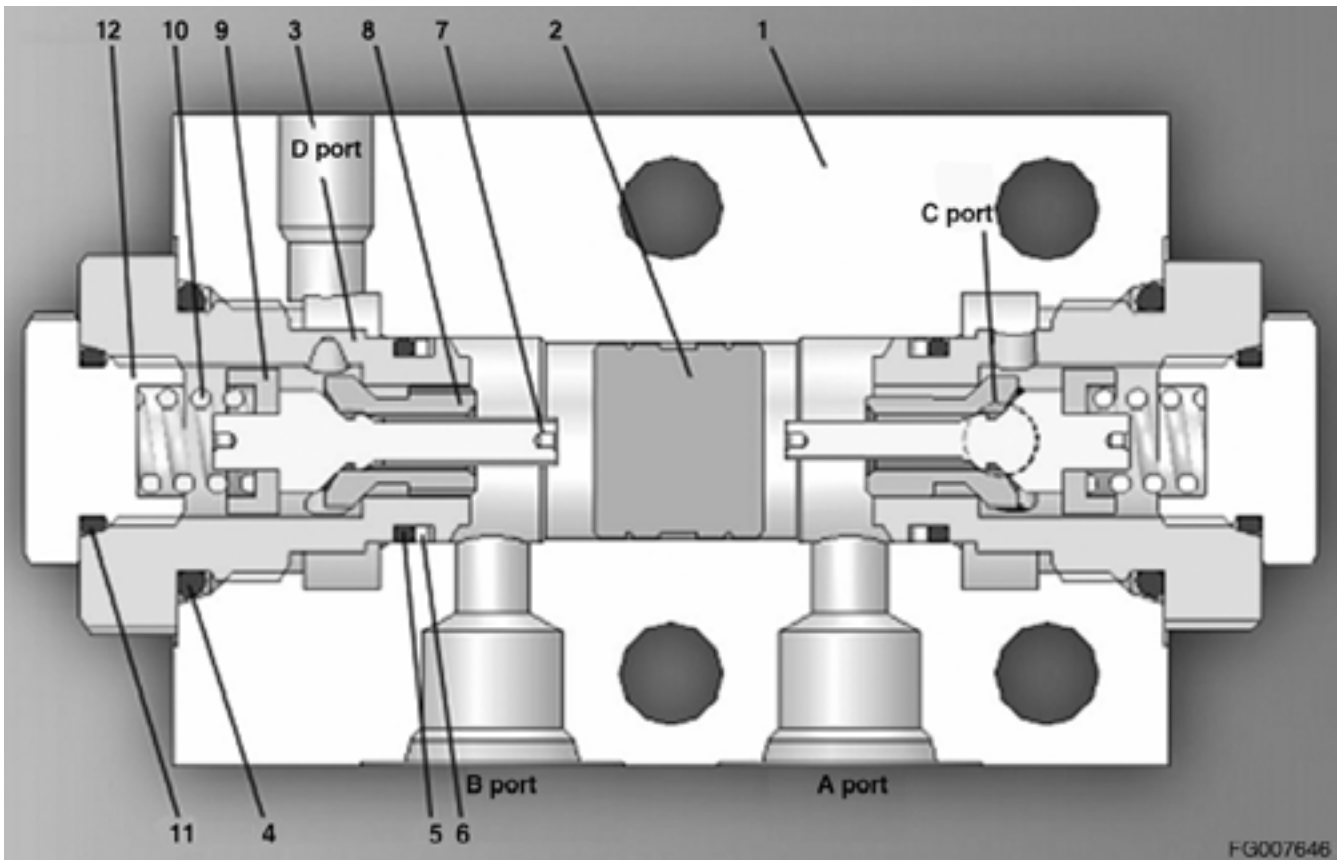

Figure 3

A → C, D → B

The pressured oil, flowed in through the A port, is to be flowed out to the C port through oil passage of the side of the nipple (3) while pressing the poppet (7) and the sleeve (8) simultaneously. The pressure of the hydraulic oil, flowed in through the A port, pushes the plunger (2) of the center to the left side. And if the pressure is greater than the spring (10) force, the poppet is to be pushed back to make a gap between the sleeve (8) and the plunger (2) and it discharges the hydraulic oil, flowed in from the D port, to the B port.

B → D, C → A

The same principle of 3.1 is to be applied to case of the hydraulic oil, flowed in through the port B.

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Front Axle

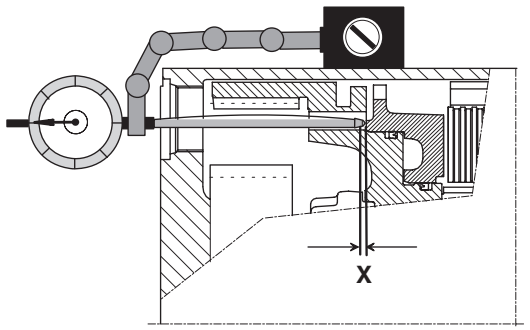

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Figure 12

Lining Wear Measurement of Multi-disc Brake

With unapplied brake, piston is in contact with ring gear by compression spring return. see Figure 11

- get dial indicator (3) into touch with piston(6) through oil filler /oil drain hole (1) and gauge hole (2).
- Apply pressure on brake and determine piston stroke (X. see Figure 12) by means of dial indicator
- Take limit value of piston stroke (at max. wear) from the chart below

Axle type	Lined discs	Piston stroke with new discs	Limit value of piston stroke (X) at max. wear
MT-E 3050	8 pcs.	1.2 ... 1.8 mm	7.0 mm
MT-E 3060	6 pcs.	0.7 ... 1.3 mm	6.0 mm
MT-E 3070	7 pcs.	0.7 ... 1.3 mm	6.5 mm
MS-E 3050	8 pcs.	1.2 ... 1.8 mm	7.0 mm
MS-E 3060	6 pcs.	1.2 ... 1.8 mm	6.0 mm
MS-E 3070	7 pcs.	1.2 ... 1.8 mm	6.5 mm

Make lining wear measurement on both outputs!

Then provide oil drain/filler plug with new O-ring and install it.

Tightening torque(M36x1.5).....M_A = 50 N•m

3. Secure knuckle housing by means of lifting device and dismantle lower bearing pin.

CAUTION!

Pay attention to releasing shim.

Figure 51

4. Remove bearing inner ring (7), O-ring (5), sealing cap (6) and brake connection screw neck (8) from bearing pin (1).

Figure 52

5. Separate knuckle housing with double u-joint shaft from axle housing.

WARNING!

Pay attention to seal ring in the axle housing - risk of damage

Figure 53

6. Pull out double u-joint shaft from knuckle housing.

WARNING!

Pay attention to seal ring in the axle housing - risk of damage

Figure 54

2. Insert the preas sembled drive pinion, mount the heated bearing inner ring until contact is obtained.

Figure 88

3. Mount flange, fix with washer and hex. nut.

   Tightening torque (M27x1.5) .....M_A = 600 N•m

Figure 89

4. Check rolling moment of pinion bearing.

   Bearing rolling moment (without seal ring) 1.0 ~ 2.0 N•m

   Try to achieve upper value.

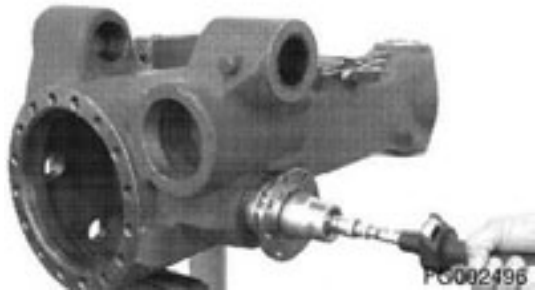


Figure 90

⚠ CAUTION!

If the rolling moment differs from the required value, correct it with a suitable spacer ring (See Figure 21 on page -17).

⚠ CAUTION!

Reassemble seal ring - as shown in page -45~74 (after completed differential assembly and positive contact pattern check).

Pre-assemble Axle Housim

1. Legend on Figure 124 ~ Figure 128

Reference Number	Description
1	Axle Housing
2	Bushing (Observe Installation Position)
3	Seal Ring (Observe Installation Position)
4	Bearing Outer Rings (Pivot Bearing)
X	Oil Chamber Side

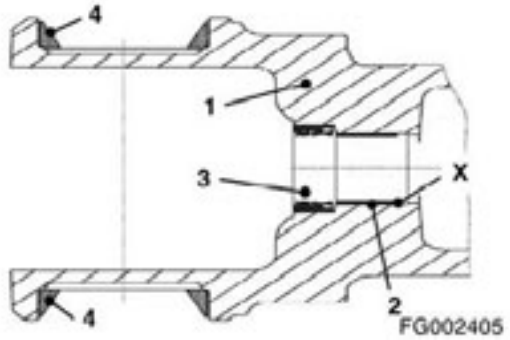


Figure 124

Bushing - lubrication groove outlet installed in 6 o'clock position (referred to the axle mounted in the vehicle).

2. Flush-mount bushing in the axle housing hole, considering the installation position (see detailed sketch).

Figure 125

Detailed sketch - 90° offset:

Reference Number	Description
1	Axle Housing
2	Bushing
X	Oil Chamber Side Observe Installation Position of Bushing

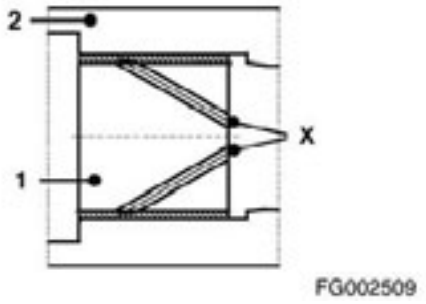


Figure 126

lubrication groove outlet in 6 o'clock position (referred to axle mounted in vehicle).

3. Flush-mount seal ring (item 3 - See Figure 124) into axle housing hole, with seal lip showing to oil chamber.

CAUTION!

Contact face (outer diameter) of seal ring:

- **Wet it with spirit (assembly aid) if rubber-coated**
- **Apply sealing agent (Loctite no. 574) if made of metal**

Apply grease on seal and dust lip of the seal ring.

Figure 127

4. Oil sealing elements and locate in annular grooves (arrows) of the ring gear - as shown in the detailed sketch.

CAUTION!

Pay attention to installation position and arrangement of sealing elements.

Figure 161

Legend to Figure 161 and detailed sketch:

Reference Number	Description
1	Ring Gear
2	Support Ring
3	U-ring
4	U-ring
5	Support Ring

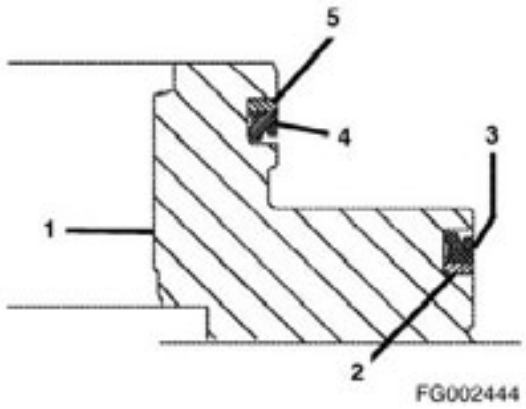


Figure 162

5. Just for "assembly of new parts" or if disassembled:

   Mount cylindrical pins into piston, considering installation dimension "X"

   MS-E 3050 = 18.00 mm

   MS-E 3060 = 16.00 mm

   MS-E 3070 = 16.00 mm

Figure 163

6. Install piston on preassembled ring gear.

Figure 164

7. Insert u-ring(6), rod wiper (7) and dual ring (8) in brake head(2).

   Observe installation position - in this connection refer to detailed sketch.

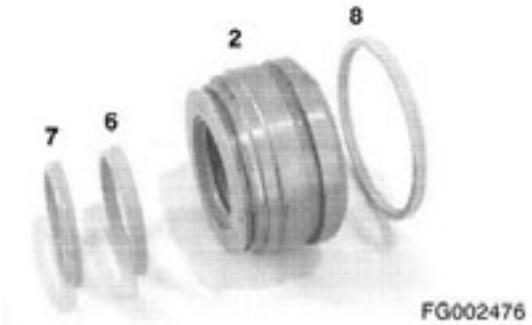


Figure 197

Detailed Sketch:

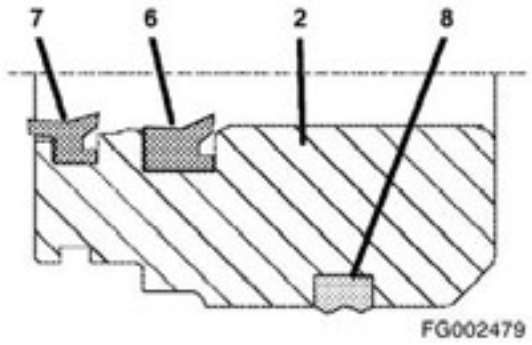


Figure 198

8. Install preassembled brake head.

CAUTION!

Slightly oil all sealing elements before inserting the brake head.

Figure 199

9. Push brake head into the steering cylinder (arrow) so that the circlip (9) can be mounted.

Figure 200

DISASSEMBLY

1. Mount the axle to the assembly truck.

   (Illustration shows axle version MT-E 3060 with attached HL-transmission)

Figure 13

2. Loosen oil drain plug and drain oil from the axle - use suitable collecting basin.

Figure 14

⚠ WARNING!

To avoid injury when opening the oil drain and oil filler plug, due to a possible pressure build-up in the oil system of the planetary carrier

- bring drain hole to topmost position (12 o'clock) and carefully unscrew oil drain and oil filler plug.

Then bring drain hole to lowermost position (6 o'clock) and drain oil from outputs - use suitable collecting basin! Then bring drain hole to 6 o'clock position and drain the oil.

Figure 15

4. Oil sealing elements and locate in annular grooves (arrows) of ring gear as shown in the detailed sketch.

Figure 54

CAUTION!

Pay attention to installation position and arrangement of sealing elements.

Legend to Figure 54 and detail

Reference Number	Description
1	Ring Gear
2	Support Ring
3	U-ring
4	U-ring
5	Support Ring

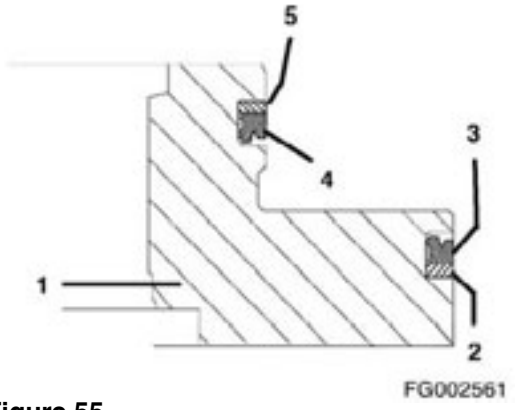


Figure 55

5. Just for. assembly of new parts. or if disassembled.

   Mount all cylindrical pins into piston considering installation dimension "X"

   MT-E 3050 = 18.00 mm

   MT-E 3060 = 16.00 mm

   MT-E 3070 = 16.00 mm

Figure 56

6. Install piston on preassembled ring gear.

Figure 57

3. Separate differential carrier halves and remove releasing single components.

Figure 93

4. Push crown wheel off from differential carrier half.

Figure 94

MEASURING POINTS AND CONNECTIONS OR INSTALLATION VIEW 2 HL 250/ 270/290 LAYOUT "AXLE ATTACHMENT"

(With electr, downshift interlock integranted in the vehicle)

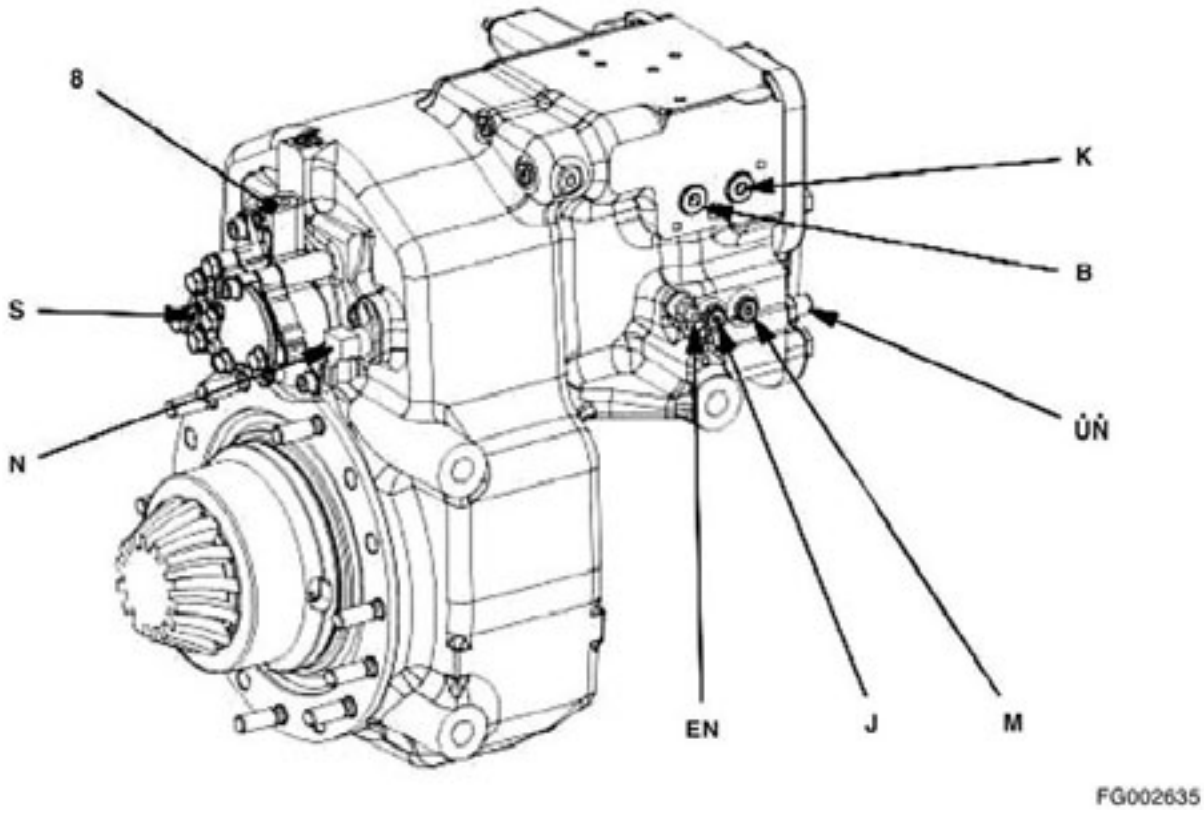


Figure 3

Reference Number	Description
8	Lube Oil Pump
B	Brake (M16x1.5)
K	Clutch (M16x1.5)
J	Road Speed (Brake - M10x1)
M	Off-road Speed (Clutch - M10x1)

Reference Number	Description
N	Speed Transmitter (Output Speed)
S	Lubrication Pressure (M10x1)
EN	Bleeder Valve (Emergency Actuation Parking Brake)
UN	Pressure Relief Valve (Emergency Actuation Parking Brake)

⚠ WARNING!

Remove the pressure ring from the ring cautiously by means of lever action - risk of damaging the sealing surfaces.

Figure 29

8. Remove the gasket and O-rings from the pressure ring / ring.

Figure 30

9. Take the disc set of the brake with end shim(s) out of the housing.

⚠ CAUTION!

Illustration shows version / components of the 2 HL-290.

Figure 31

10. Unsnap the retaining ring.

Figure 32

Version - "Separate Installation"

(HL-Transmission installed separately from the axle)

In case of the transmission version "Separate Installation" it is possible, differently from the transmission version "Axle Attachment", to remove and to install the output - without the previous disassembly of brake/clutch and planet carrier.

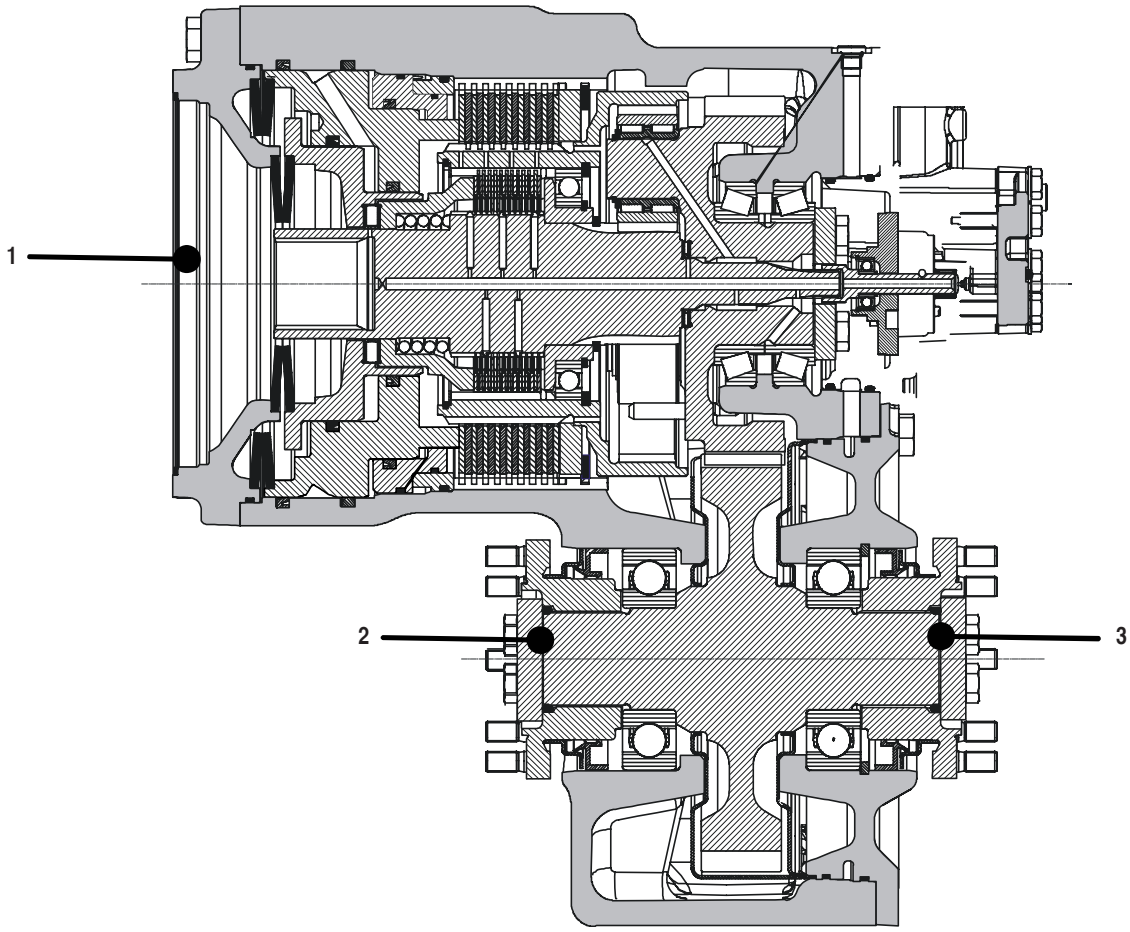


Figure 67

1. Legend to Figure 67

Reference Number	Description
1	Input
2	Output - Front Axle
3	Output - Rear Axle

Determine the Adjusting Ring for Rolling Moment/Pinion Bearing

1. Rotate the transmission by 180°.

   Mount the adjusting ring (s = optional).

CAUTION!

It is recommended to reinstall the adjusting ring (e.g. s = 1.35 mm) from the disassembly, if however the required rolling moment of 1.5 ~ 3.0 N•m (without shaft seal) is not obtained - see bearing rolling moment check Figure 104 - the bearing rolling moment is to be corrected with an adequate adjusting ring.

Figure 99

2. Mount the heated bearing inner ring and install it subsequently until contact.

Figure 100

3. Mount the flange.

Figure 101

4. Put on the washer and fasten the flange with hexagon screws.

CAUTION!

Rotate the pinion - when tightening - in both directions (aligning of rollers) several times.

Tightening torque (M 10/8.8) ..... M_A = 46 N•m

Figure 102

7. Position the washer and fasten the output flange by means of hexagon screws.

Figure 132

CAUTION!

Install the second shaft seal/output flange (front axle output) analogously.

WARNING!

Prior to put the unit into operation the specifications and regulations respectively as well as the instructions of the operating and maintenance instructions as well as the specifications and instructions of the vehicle manufacturer have to be observed.

B. Insert the end shim (2).

Figure 166

C. Insert the disc set (outer/inner discs) - beginning with an outer disc - alternately.

CAUTION!

Position the outer disc (1 Pc.) s = variable 2.8 ~ 3.7 mm, in the disc set on the top (piston-side).

With outer disc s = variable, the disc clearance/ piston stroke will be adjusted - See Figure 180.

Figure 167

D. Clutch:

Insert the disc set (outer/inner discs) - beginning with an outer disc - alternately.

CAUTION!

Position the outer disc (1 Pc.) s = variable 1.2 ~ 1.6 mm, in the disc set on the top (piston side).

With outer disc s = variable, the disc clearance/ piston stroke will be adjusted - See Figure 179.

Figure 168

Adjust and check the Disc Clearance/Piston Stroke of Brake and Clutch

1. Mount the pressure piece (without compression spring).

Figure 169

Emergency Release (Parking Brake)

Legend to Figure 206:

Reference Number	Description
1	Input Housing
2	Housing
3	O-ring
4	Threaded Element (Orifice)
5	Ball
6	Compression Spring
7	O-ring
8	Bleeder
9	Position of lubrication nipple for the version "Transmission Installation Position Vertical" - Position of lubrication nipple for the version "Transmission Installation Position Horizontal" -See Figure 211

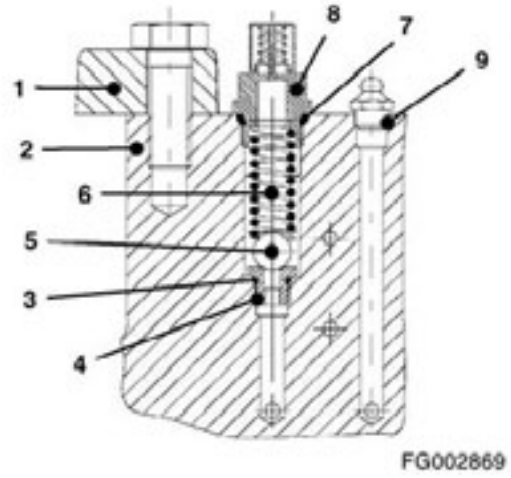


Figure 206

1. Install the threaded element (4) with O-ring (3).

   Tightening torque (M 10x1) ..... M_A = 24 N•m

Figure 207

2. Insert the ball (5).

Figure 208

5. Loosen pump cover bolt connection.

Figure 237

⚠ CAUTION!

Keep pump to contact and rotate it by 180° - disassembly aid.

Figure 238

6. Then pull the pump in vertical position out of the housing - pay attention to possibly released balls/compression springs (See Figure 239 and 248).

7. Remove the outer (1) and internal rotor (2) and take the released ball [(3) driver] out of the control housing (4).

   Outer, internal rotor and control housing = rotor set

Figure 239

8. Remove the control housing and the released balls and compression springs (3 pcs. each).

Figure 240

6. Secure the check valves and the pressure limiting valve by two blows each with the center punch.

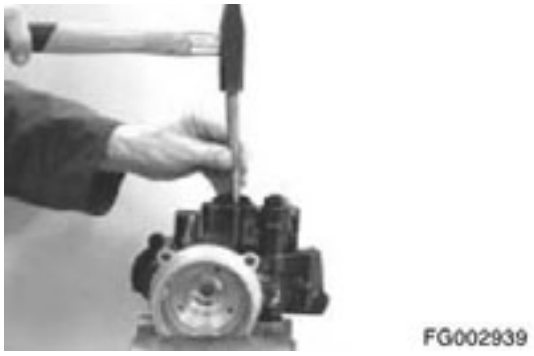


Figure 275

7. Check passage of the orifice / oil bore in the housing bottom.

CAUTION!

Insert the needle sleeve to installation dimension "X".

"X" = 0.2 ~ 0.7 mm below plane face/housing

CAUTION!

The exact installation position is ensured by use of the specified mounting tool.

CAUTION!

Insert the needle sleeve with marked face showing upwards.

Figure 276

8. Mount the ball bearing onto the shaft and fasten it with the retaining ring.

Figure 277

Hydraulic System Troubleshooting, Testing and Adjustment

Edition 1

Arm Crowd Circuit

When the arm control lever is put in the crowd mode, the left side pilot valve generates secondary pressure that is transmitted to the right and left sides of the control valve simultaneously.

When secondary pilot pressure reaches 7 - 9 kg/cm^2 (100 - 128 psi), the arm control valve spool on the right and left sides of the control valve opens. Output flow from both halves of the pump assembly is directed to the arm cylinder.

When working in the arm crowd mode, under certain conditions, oil in the cylinder could suddenly be forced out by the weight of the arm and bucket itself. Insufficient oil flow to the cylinder could lead to cavitation in the cylinder and/or surging or irregular movement. This is prevented by a regeneration valve attached to the control valve which maintains the balance between oil flowing into the cylinder and oil flowing out.

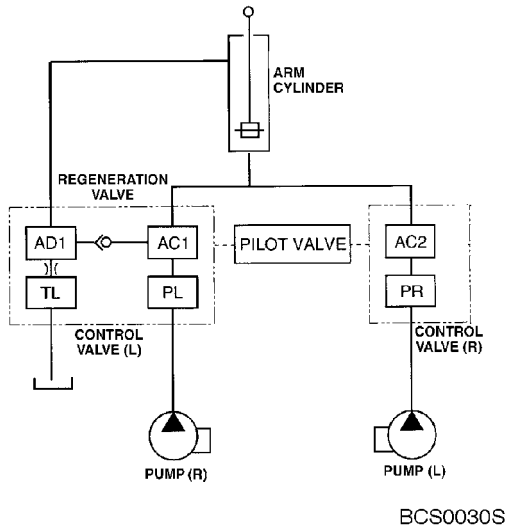


Figure 4

Arm Dump Circuit

When the arm control lever is put in "dump" mode, the left side pilot valve generates secondary pilot pressure that goes to both halves of the control valve simultaneously.

When pilot pressure reaches 7 - 9 kg/cm^2 (100 - 128 psi), the control spools open on both sides allowing oil from the right and left pumps to flow to the arm cylinder.

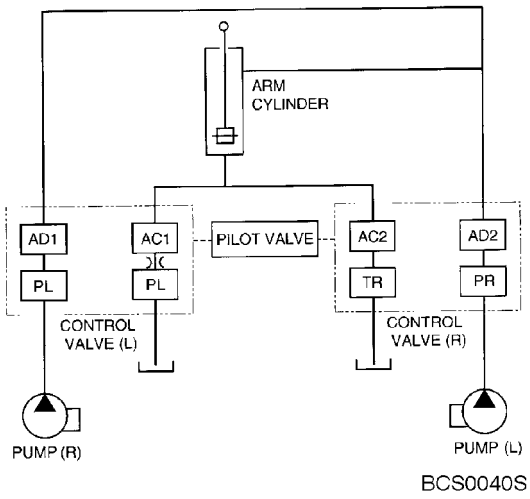
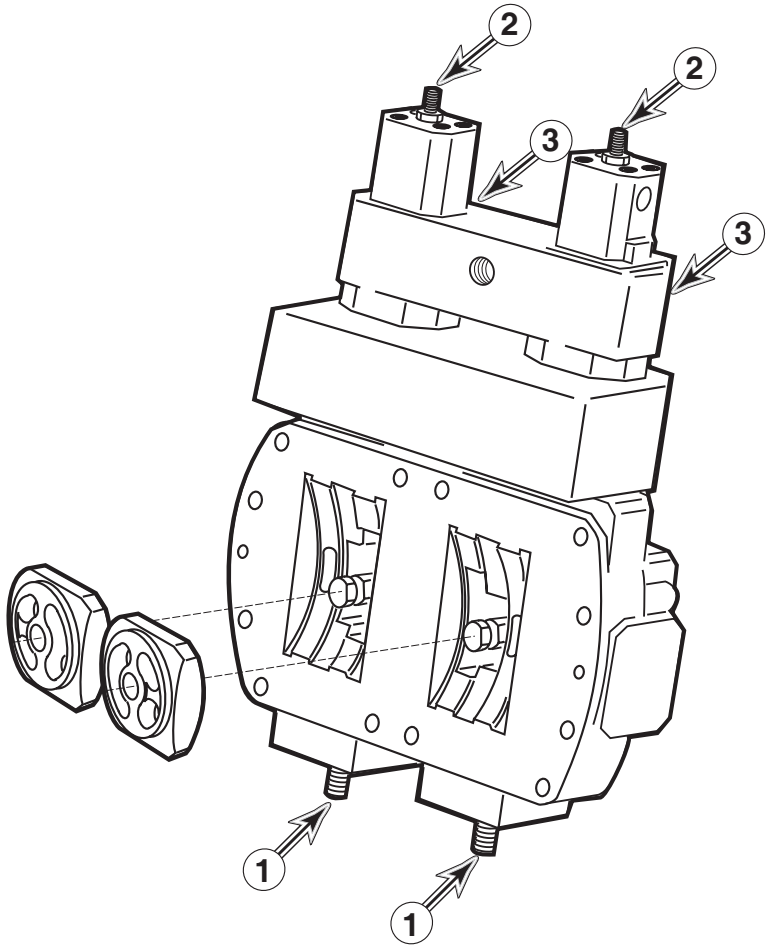


Figure 5

Bucket Operating Circuit

The bucket operating circuit includes the right and left main pumps, the right and left halves of the control valve and the bucket cylinder. 360 kg/cm^2 (5,112 psi) overload relief valves at BKC and BKD 1 ports of the control valve protect the circuit and its components from damage.

adjustment, the pump which supplies output to the track frame toward which the excavator is veering is weak.



ASS0320L

Figure 10

Refer to the illustration of the pump regulator control valve (Figure 10) for the location of adjustment screws (1, 2 and 3). There are two different adjustments, along with the Negacon, negative control, adjustment screw (3, directly below 1 and 2). Each one of the adjustment procedures could affect the setting of the others.

Check and record the arm dump speed performance test before and after input power adjustment, whether or not a flow meter is used.

NOTE: *Regulator adjustments affect total cumulative horsepower, since each regulator compensates for the output of the other. It is not necessary to adjust both regulators at the same time, but after checking or adjusting one of them, the remaining unit should also be checked.*

Problem	Possible Cause	Remedy
Pressure does not increase at all.	Main poppet or pilot poppet stuck open.	Clean/replace.
Irregular or uneven pressure.	Poppet seat damaged or pilot piston sticking to main poppet.	Clean/replace.
	Loose lock nut and adjusting screw.	Readjust.
	Components worn out, past wear limits.	Replace.

TROUBLESHOOTING – TRAVEL CONTROL VALVE

Problem	Possible Cause	Remedy
Secondary pressure does not increase.	Low primary pressure.	Check primary pressure.
	Broken spring.	Replace spring.
	Spool sticking.	Clean, repair or replace.
	Excess spool to casing clearance.	Replace spool casing.
	Worn or loose universal joint (handle) subassembly.	Repair or replace U-joint subassembly.
Secondary pressure too high.	Dirt, other interference between valve parts.	Clean, repair or replace.
	Return line pressure too high.	Redirect return line.
Secondary pressure does not hold steady.	Dirt, other interference between valve parts, or worn spool sticking intermittently.	Clean, repair or replace.
	Interference or binding on spool return spring.	Clean, repair or replace.
	Interference, restriction or unsteady pressure in tank return line.	Repair or reroute tank return line.
	Air bubbles in piping (temporary) or air leak.	Vent air, or repair leak.
NOTE: *Look for evidence of leaking oil.*		

Specifications

Model	Serial Number	System	Charge Pressure	Volume
DX140W DX160W DX190W DX210W	S/N 5001 and Up	Pilot	15 kg/cm^2 (213 psi)	320 cc (19.53 in^3)
		Brake	30 kg/cm^2 (427 psi)	750 cc (45.77 in^3)

DISASSEMBLY

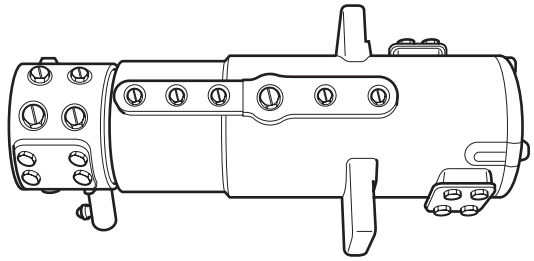
Refer to the assembly drawing of the swivel joint for component references (Figure 1).

IMPORTANT

Do not unbolt the center joint from the lower car body until an adequate number of piping block-off plates are available, for disconnected piping lines. Be sure that system pressure has been vented - including the hydraulic accumulator and tank reserve pressure - before disassembly is started.

1. Remove the Swivel Joint from the Vehicle

   Move the Swivel Joint removed from the vehicle to the work table using a crane.

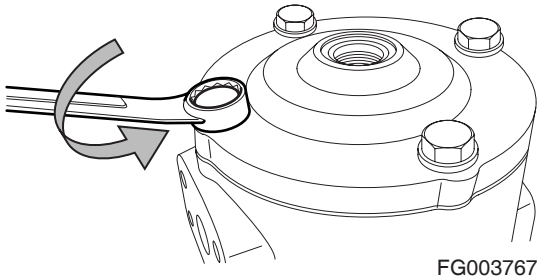


FG003764

Figure 3

2. Remove Cover

   - Remove the bolts and washers using a spanner (wrench) or air impact.
   - Remove the cover.



FG003767

Figure 4

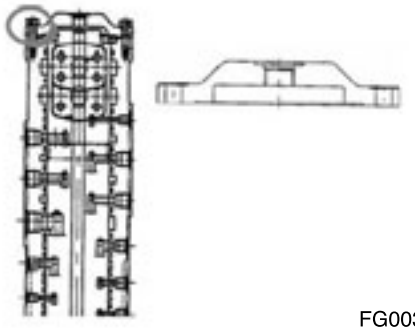


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Figure 5

GENERAL DESCRIPTION

Two essentially similar types of hydraulic cylinders are used on the excavator. The cylinder that is used to operate the excavator boom or bucket is equipped with a rod stopper, which acts as a cushion only when the cylinder rod is fully retracted (and the bucket is pulled close to the arm). This type of cylinder is shown in the lower drawing.

Arm cylinders have a cushion or stopper for operation in both directions. This type of cylinder is shown in the upper drawing.

Theory of Operation

1	**Piston**
2	**Oil Path A**
3	**Oil Path B**

Cylinder piston rods are extended or retracted by oil flow to the back side of the cylinder (shown as ("oil path A") or to the front of the cylinder ("oil path B").

The cylinder rod is extended as oil flow is pumped through the circuit to the back side of the piston. The force (F1) of the piston stroke can be expressed by the formula below, where P = circuit oil pressure and the inside diameter of the cylinder is expressed by D (Figure 1).

$$F_1 = P \times \frac{\pi D^2}{4}$$

(P: Pressure, π = 3.14, D: Cylinder Inside Diameter)

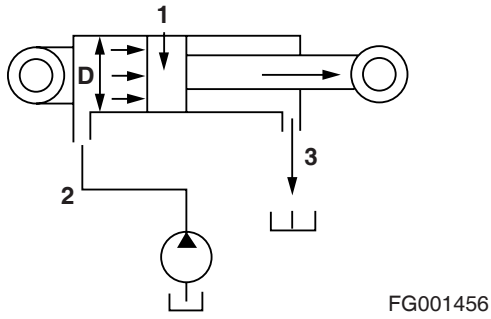


Figure 1

1	**Cylinder Inside Diameter - D**
2	**Oil Path A**
3	**Oil Path B**
4	**Rod Diameter - R**

When the cylinder rod is retracted, oil flow through the circuit from the pump to the front side of the cylinder generates a force (F2) that can be expressed by the formula in which the diameter of the piston rod is expressed by R, and the other two terms are the same as in the preceding expression.

$$F_2 = P \times \frac{\pi(D^2-R^2)}{4}$$

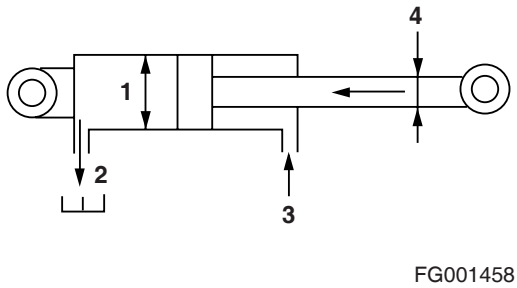
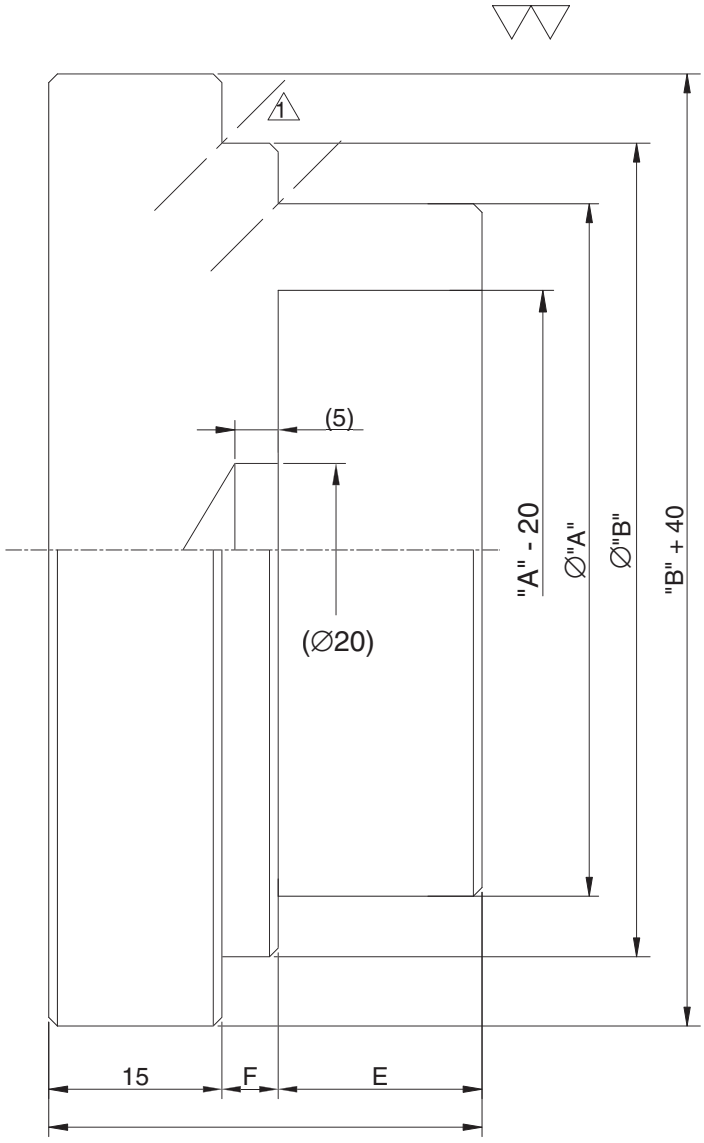


Figure 2

Steel Bushing Jig



ARS4750L

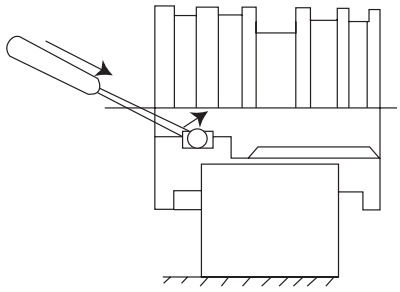
Figure 11

Material: SM45C which is done thermal refining <QT> Hrc 22 - 28

Undefined Chamfer C/R = 0.5 Max.

1 Place: Finally work to used DNMG Tip <Nose R0.4>

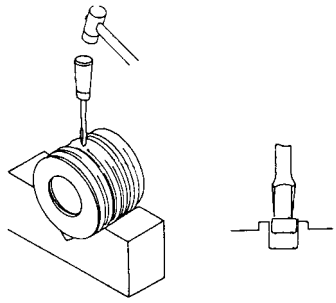
12. Use a dull, rounded tip tool to pry off O-ring (13) and backup ring (14).



HAOF37OL

Figure 26

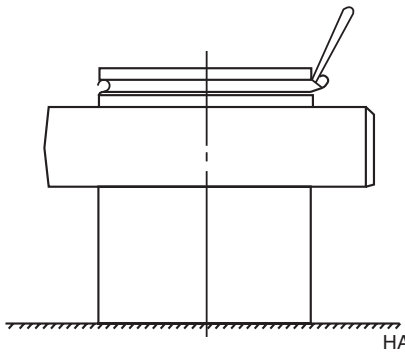
13. Find a screwdriver with an appropriate width tip to facilitate removal of slipper seal (18), wear ring (19) and slide ring (20) from piston (17).



0345

Figure 27

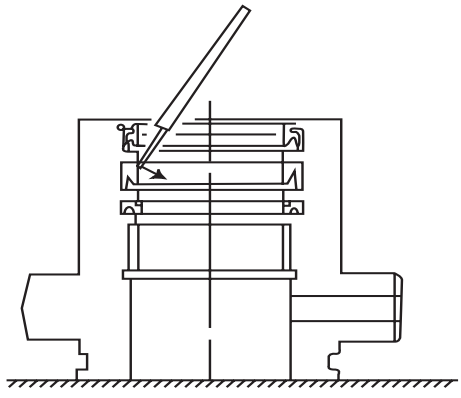
14. Remove O-ring (21) and backup ring (22) from cylinder head.



HAOF38OS

Figure 28

15. During disassembly of cylinder head, be careful not to damage buffer seal (8) and U-packing (9).



HAOF39OL

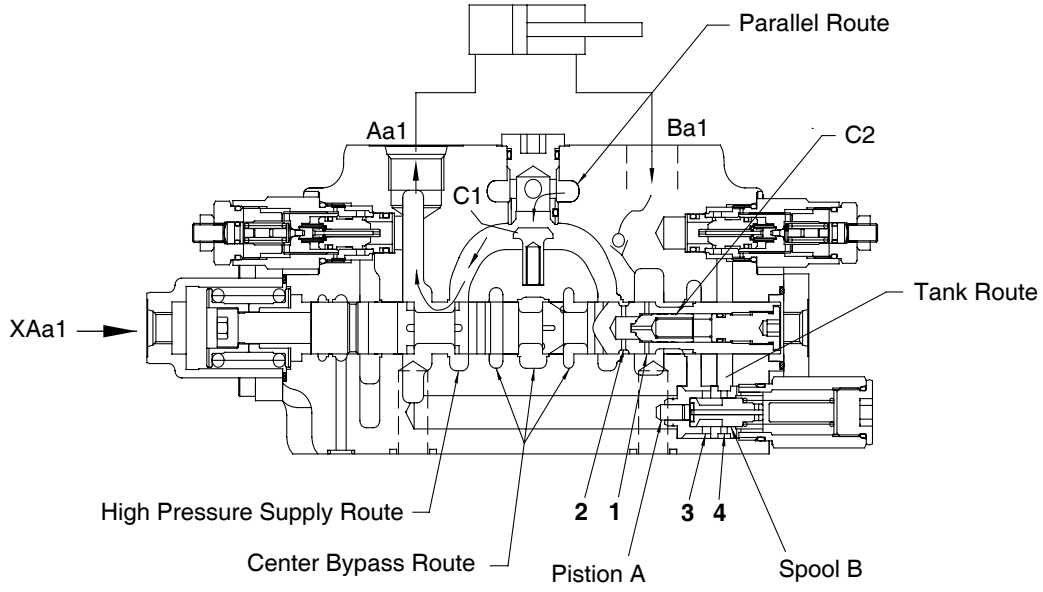
Figure 29

CONTROL VALVE OPERATION

Following pages show the various functions of the control valve with a brief description of each function.

They are;

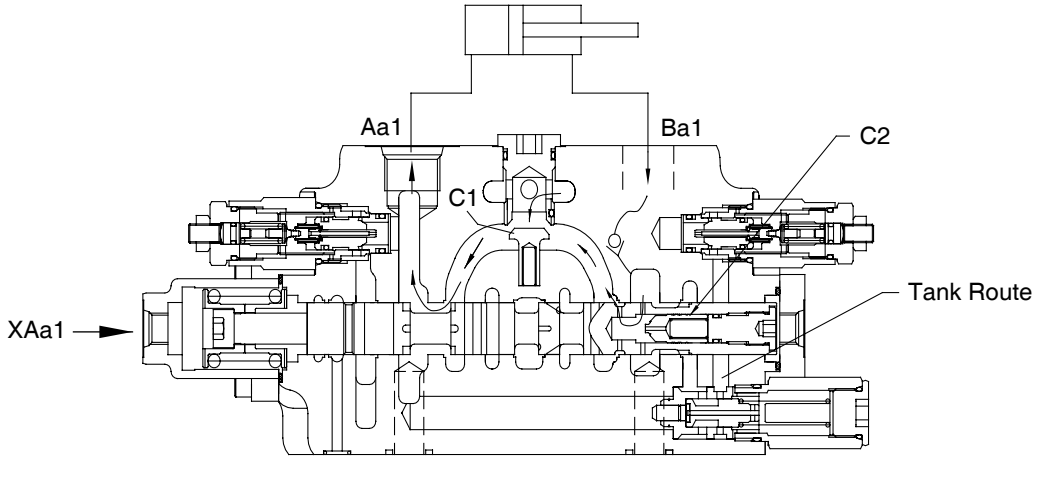
Arm Regeneration



FG003186

Figure 18

1.



FG003187

Figure 19

2.

Center Bypass Valve [Cb Valve]

Reference Number	Description
1	Cap
2	O-ring
3	Spring
4	Cb Spool

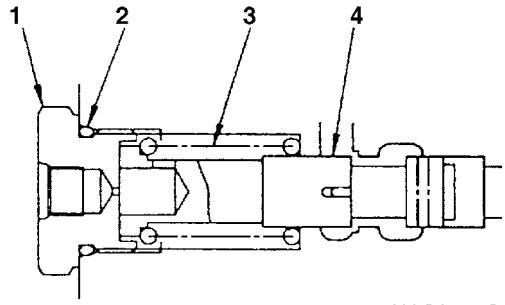


Figure 39

Arm Load Holding Valve

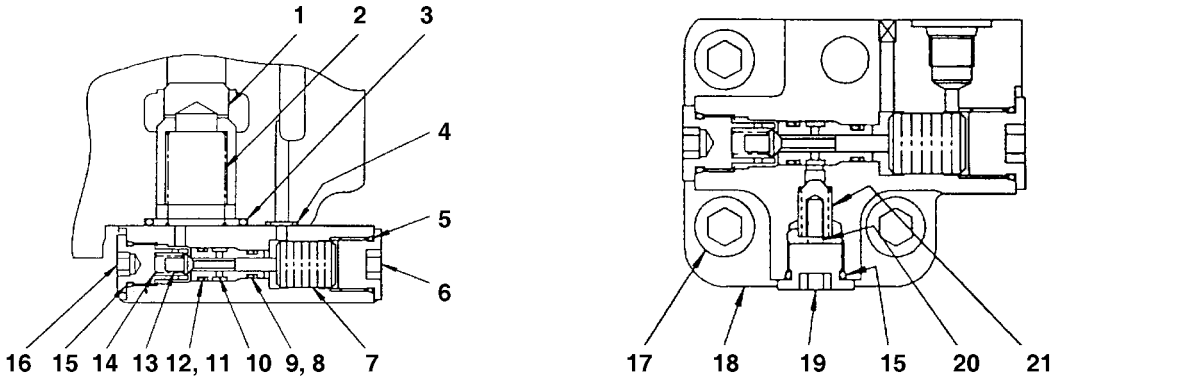


Figure 40

Reference Number	Description
1	Poppet
2	Spring
3	O-ring
4	O-ring
5	O-ring
6	Cap
7	Piston
8	Backup Ring
9	O-ring
10	Sleeve
11	Backup Ring

Reference Number	Description
12	O-ring
13	Poppet
14	Spring
15	O-ring
16	Cap
17	Bolt With Hole
18	Cover
19	Cap
20	Spring
21	Check

Tightening Torque	10 kg•m (72 ft lb)

Main Relief Valve Adjustment

IMPORTANT

Improper relief valve pressure settings may cause severe damage to the hydraulic system. Extreme caution should be taken when making pressure adjustments.

IMPORTANT

Inspect all O-ring gaskets for damage and replace as necessary. Never reuse damaged or questionable O-rings.

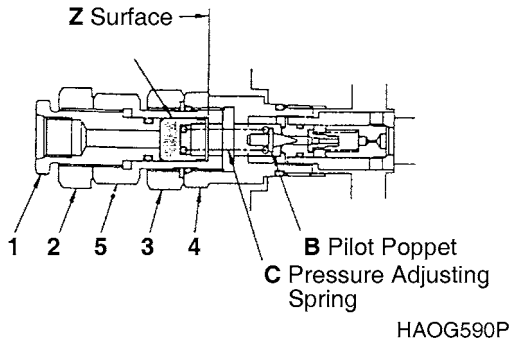


Figure 59

High Pressure Adjustment

1. Install an accurate pressure gauge at the discharge outlet of the hydraulic pump.
2. Start the engine and drive hydraulic pump at normal rpm.
3. Completely stroke one of BM-up, AM or BKT plungers and read pressure gauge.
4. Adjust pressure by turning sleeve (7) while monitoring pressure gauge. Each 1/4 turn changes pressure by approximately 45 kg/cm² (640 psi)

IMPORTANT

The relief valve is extremely sensitive and sudden extreme changes should be avoided.

5. Tighten hexagonal nut (3) while sleeve (7) is secured. Recheck high side pressure.

TIghtening Torque	6 kg•m (43 ft lb)

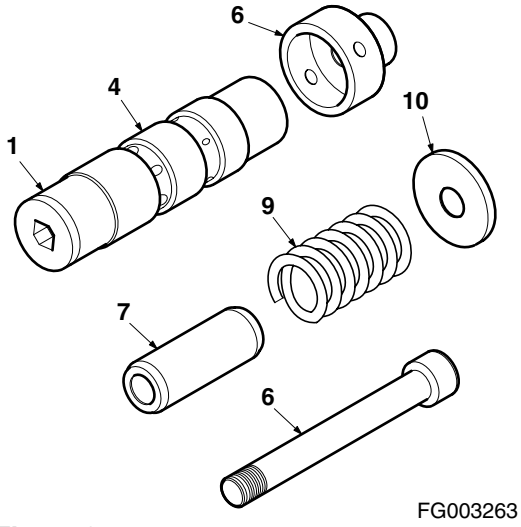
Low Pressure Adjustment

1. After the High Pressure adjustment has been completed, Low Pressure adjustment can be made by turning the Adjust screw (1).
2. After the desired pressure has been adjusted, tighten hexagonal nut (2) while adjust screw (1) is secured. Recheck low side pressure.

TIghtening Torque	6 kg•m (43 ft lb)

2. Side out spool assembly and using the tool described above, clamp and hold the spool assmbly in space. Remove bolt with hole (8).

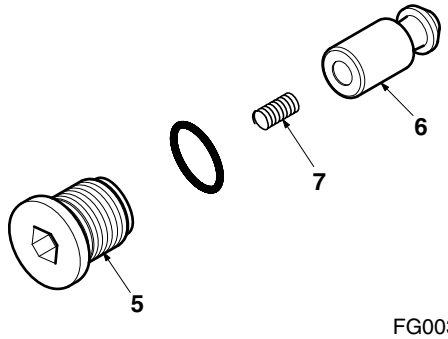
Lower Cap Hex Hole (1)	6 mm
Tightening Torque	3 kg•m (22 ft lb)



FG003263

Figure 85

3. Using the tool discribed above, clamp and hold the spool (4) in place. Remove cap (5), spring (6), and check (7).



FG003264

Figure 86

Boom Unity Check Valve

IMPORTANT

When disassembling Boom Unity Check Valve, tag and label each component so that all parts can be reassembled in the proper order.

IMPORTANT

When assembling components, inspect O-rings for any damage and replace as necessary.

SAFETY PRECAUTIONS

CAUTION!

Follow all safety recommendations and safe shop practices outlined in the front of this manual or those contained within this section.

Always use tools and equipment that are in good working order.

Use lifting and hoisting equipment capable of safely handling load.

Remember, that ultimately safety is your own personal responsibility.

APPLICABLE MODELS

The contents of this section apply to the following models and serial number ranges.

MODEL	SERIAL NUMBER RANGE
DX140W	5001 and Up
DX160W	5001 and Up
DX190W	5001 and Up
DX210W	5001 and Up

Precaution in Use

Inspection

Prior to installation of a new motor, inspect the following items.

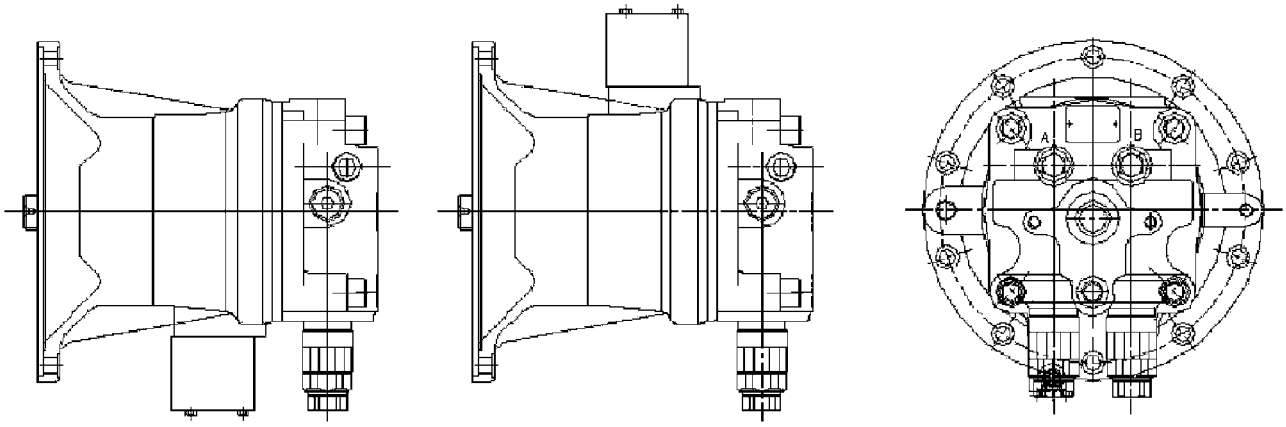
1. Inspect whether or not there is any damage during transit, or if any parts are lost missing.
2. Inspect each tightened part is loosened or not.
3. Check whether or not covers for flange surface and drain port are perfect, and the inside of the motor is dirty with intruded dust.

Rotation Direction

The relation between the oil flow and the revolutionary direction of the shaft is self-explanatory as shown in Figure 7 and table.

The revolutionary direction of a motor vary according to the slope surface of casing.

Pay attention to discriminate between geometry of casing and the direction of flange as the direction of tilting angle.



Anti-clockwise Clockwise (Attach a label M type)

FG007425

Figure 7 Brake Working Description

Direction	Inlet Port	Outlet Port	Revolutionary Direction of Shaft Facing the Shaft Side
Anti-clockwise	A	B	Right-handed
Clockwise	B	A	Left-handed

Procedures for Disassembly

Please use the following procedures for the inspection and repair of the motor.

Numerals given in parentheses following the parts names indicate the parts number shown by the drawing in the instruction and maintenance manual.

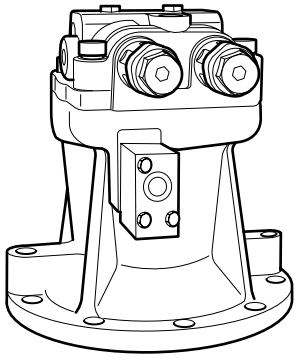
1. Wind the wire rope at motor outside, lift up the motor, and clean the motor with cleaning oil.

   After cleaning, dry with compressed air.

2. Draw the oil out of the casing (301).

3. Mount on a suitable table for the driven-axis (201) below.

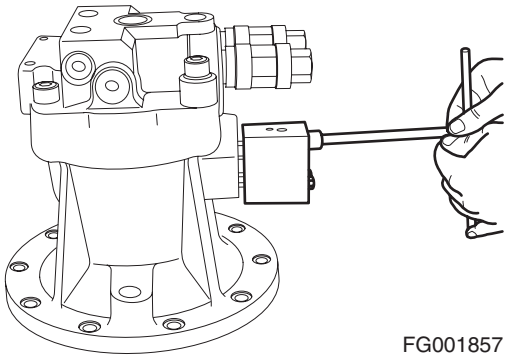
   Before disassembling make a match mark on motor casing (301) and valve casing (101).



FG001856

Figure 12

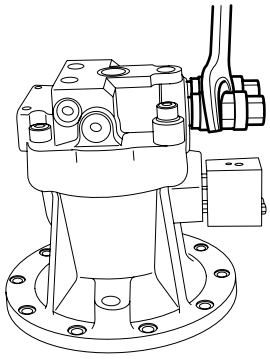
4. Remove brake valve (400).



FG001857

Figure 13

5. Remove relief valve (107) from valve casing (101).

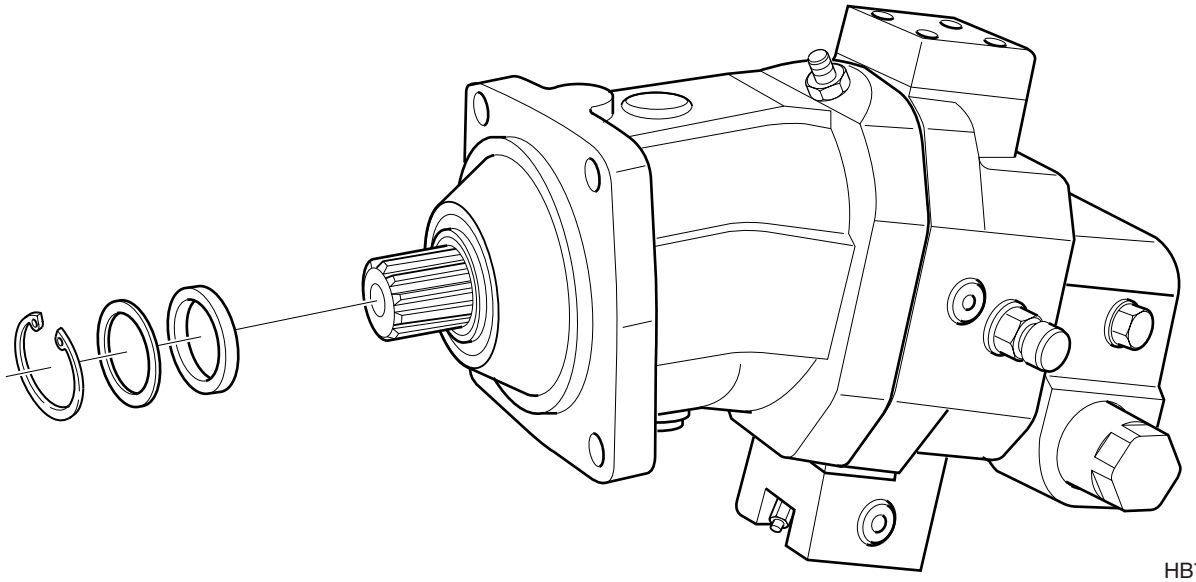


FG001858

Figure 14

DISASSEMBLY

Sealing the Drive Shaft

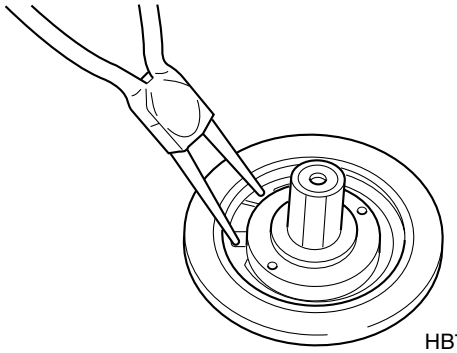


HB7M3016

Figure 16

1. Protecting the drive shaft.

   Remove retaining ring and shim.

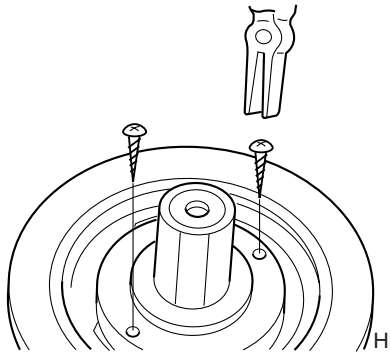


HB7M3017

Figure 17

2. Screw in sheet metal screw into the holes fitted with rubber.

   Pull out seal with pliers.



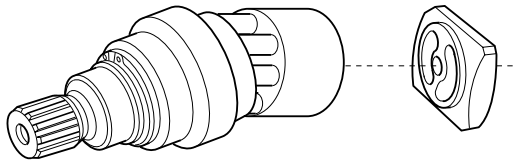
HB7M3018

Figure 18

Exchanging of the Rotary Group

CAUTION!

Setting of hydraulic part necessary.



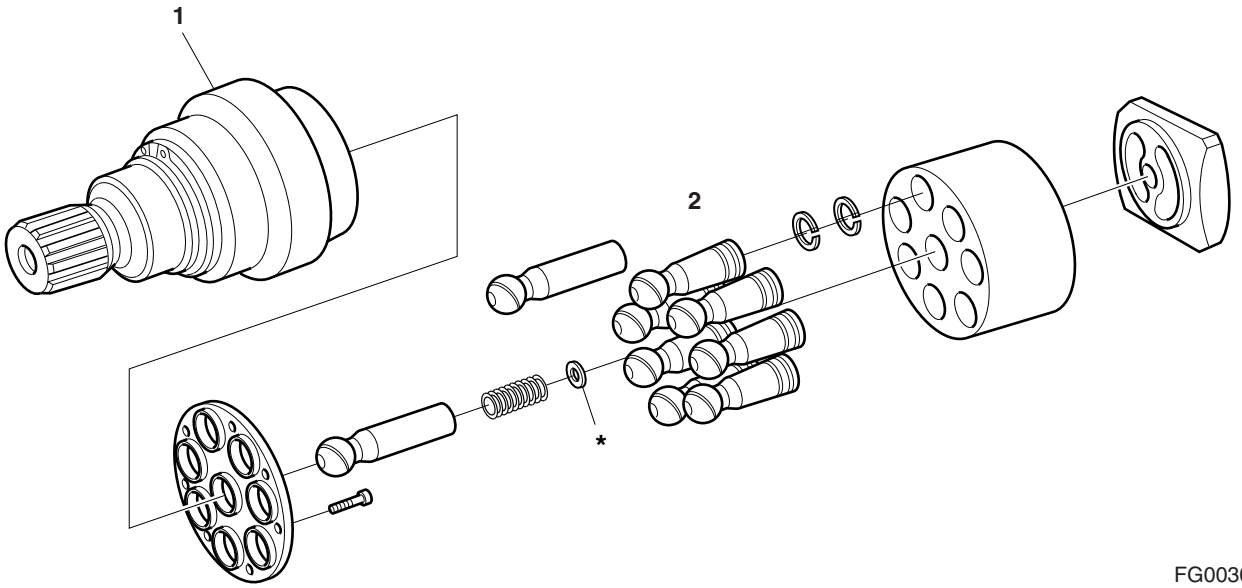
HB7M3010

Figure 45

1. Rotary group
   A. Mechanical part: Adjust drive shaft with bearing.
   B. Hydraulic part:

CAUTION!

Adjustment necessary.



FG003029

Figure 46

Seal-Lock Nuts

(Metric ISO-Standard Thread)

The values for tightening torques shown in the table are valid only for seal-lock nuts of the strength class 8.8 and with metric ISO-standard thread.	Thread Size	Strength Classes		
		8.8	10.9	12.9
		Tightening Torque (lb.ft)		
	M 6	7.4		
	M 8	16.2		
	M 10	29.5		
	M 12	50.9		
	M 14	81.1		
	M 16	125.3		

Cross-slotted Lens Head Screws DIN 7985

(Metric ISO- Standard Thread)

The values for tightening torques shown in the table are valid only for cross-slotted lens head screws DIN 7985 of the strength class 8.8 and with metric ISO-standard thread.	Thread Size	Strength Classes		
		8.8	10.9	12.9
		Tightening Torque (lb.ft)		
	M 3	0.8		
	M 4	2.1		
	M 5	4.4		
	M 6	7.4		
	M 8	18.4		
	M10	36.1		

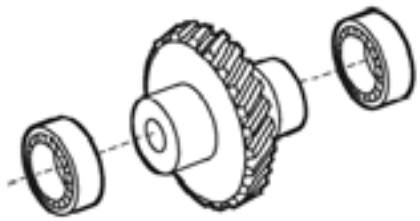
While Operating to Back

Backward operation also has counterbalancing function like forward operation. The spool moves to left when motor works either for accelerated climbing or for uniform running on a flat road, while oil flows through individual ports (B → B' to Motor to A' to A). While in deceleration and in decent, counter pressure is produced at B' port, contrary to the case of forwarding, causing vehicle body to be under control. While in operation to stop, spool moves toward neutral position and counter pressure produced from neutral orifice (at B' port) produces braking pressure of the relief valve, which forces the vehicle body to stop.

Main Pump & PTO

Edition 1

11. Auxiliary Drive



FG003073

Figure 17

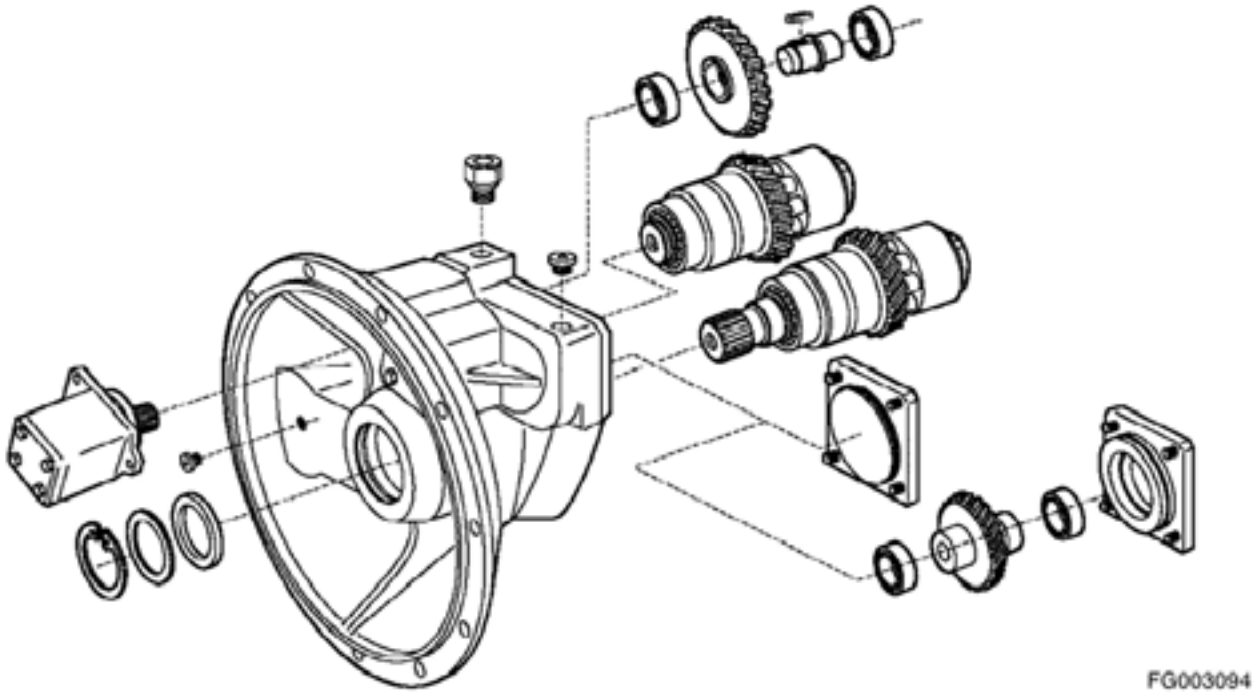


Figure 38

1. Keep the cylinder with a device (Remove it completely with the drive shaft).

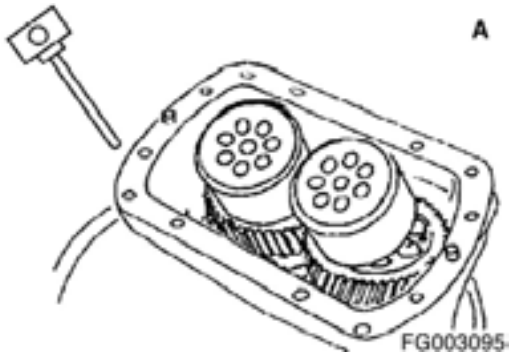


Figure 39

2. Remove cylinder (Take out the drive shaft without cylinder).

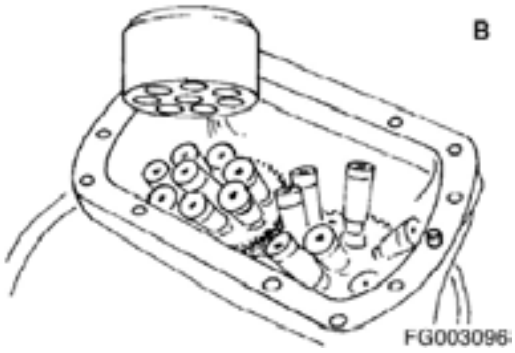


Figure 40

12. Complete Rotary Group

    (1) Rotary Group

        A. Mechanical component: drive shaft is adjusted with the bearing

        B. Hydraulic component: Adjustment is necessary *.

CAUTION!

Adjustment of the hydraulic component is necessary.

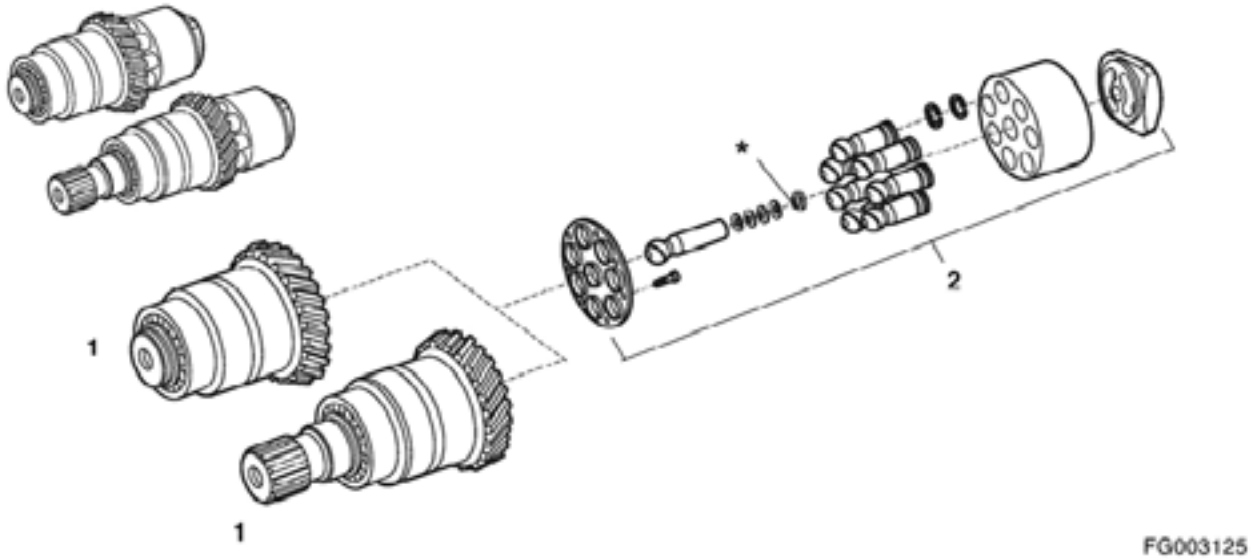


Figure 69

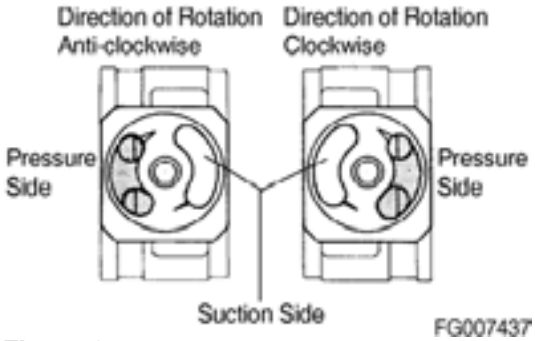


Figure 97

4. Fit the control lens in its correct position using grease to hold it in place.

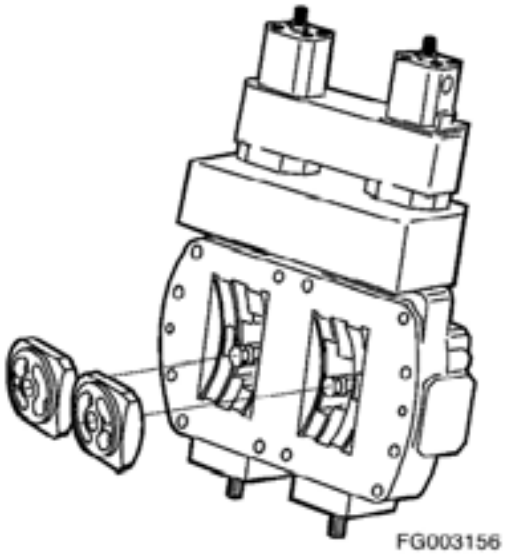


Figure 98

5. Fit seal* and controller.

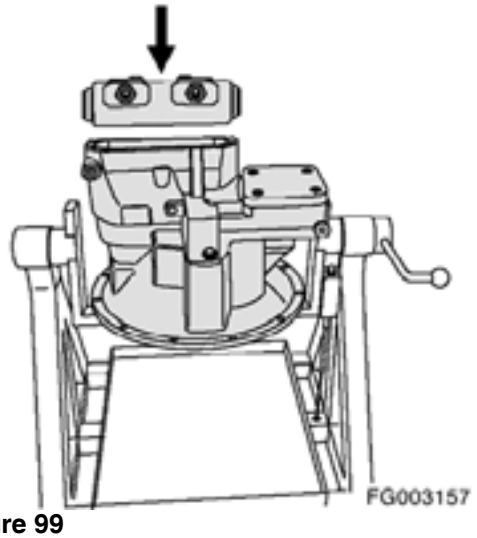


Figure 99

7. Insert pressure plate assembly into body while keeping plate straight.

   NOTE: *Seal side should face to rear cover, opposite side of gears.*

   NOTE: *Pay attention to direction of seal.*

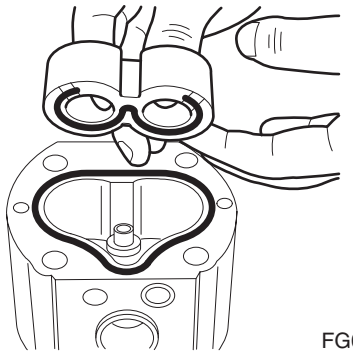


Figure 37

8. Install drive gear and driven gear.

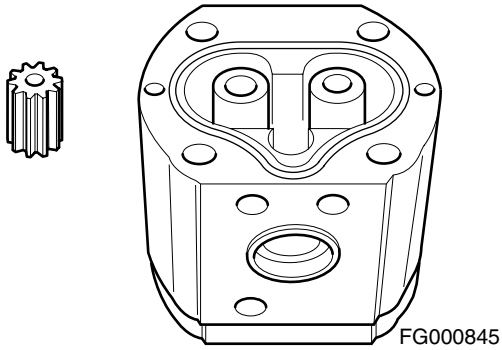


Figure 38

9. Insert pressure plate into body in proper direction.

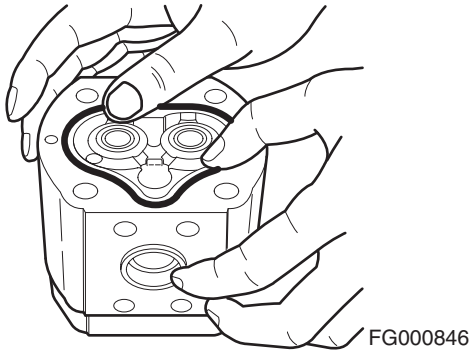


Figure 39

10. Install intermediate cover, one rear section, and through shaft.

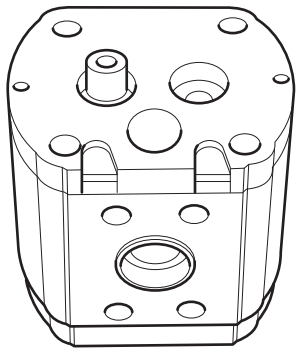
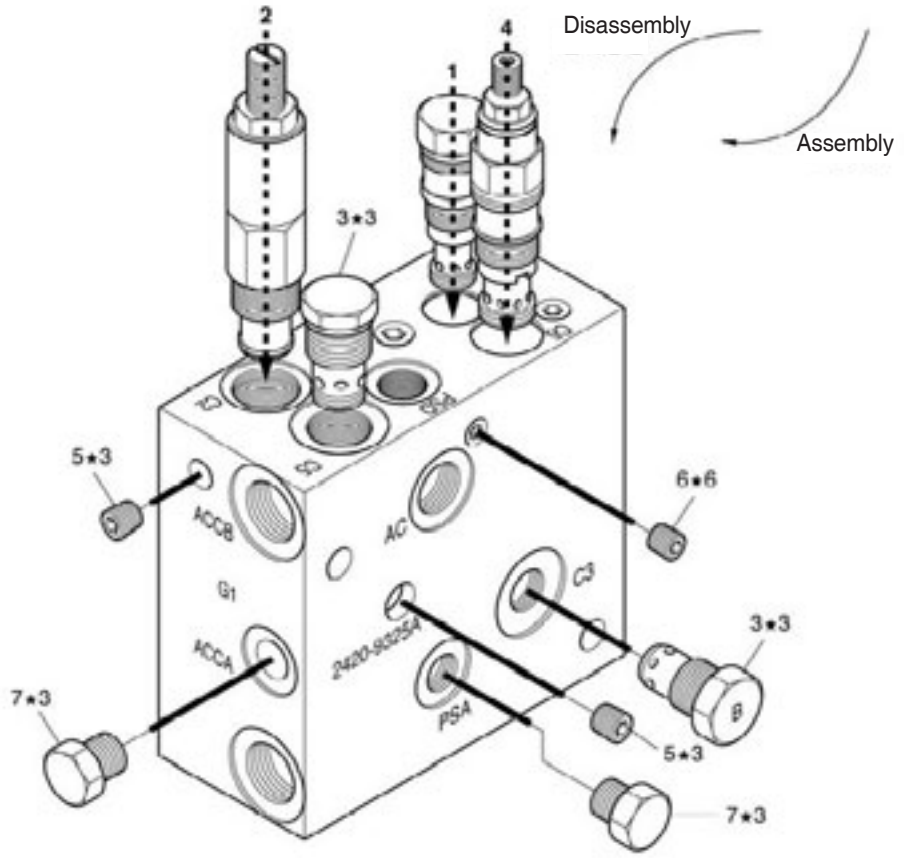


Figure 40

Exploded View and Tools

The assembly torque of each part in the Brake Supply Valve Assembly Package is described in <Table 1>. Observe the specified torque values using the right tool.

1. Disassembly, re-assembly of Brake Supply Valve Assembly Package, and necessary tools.

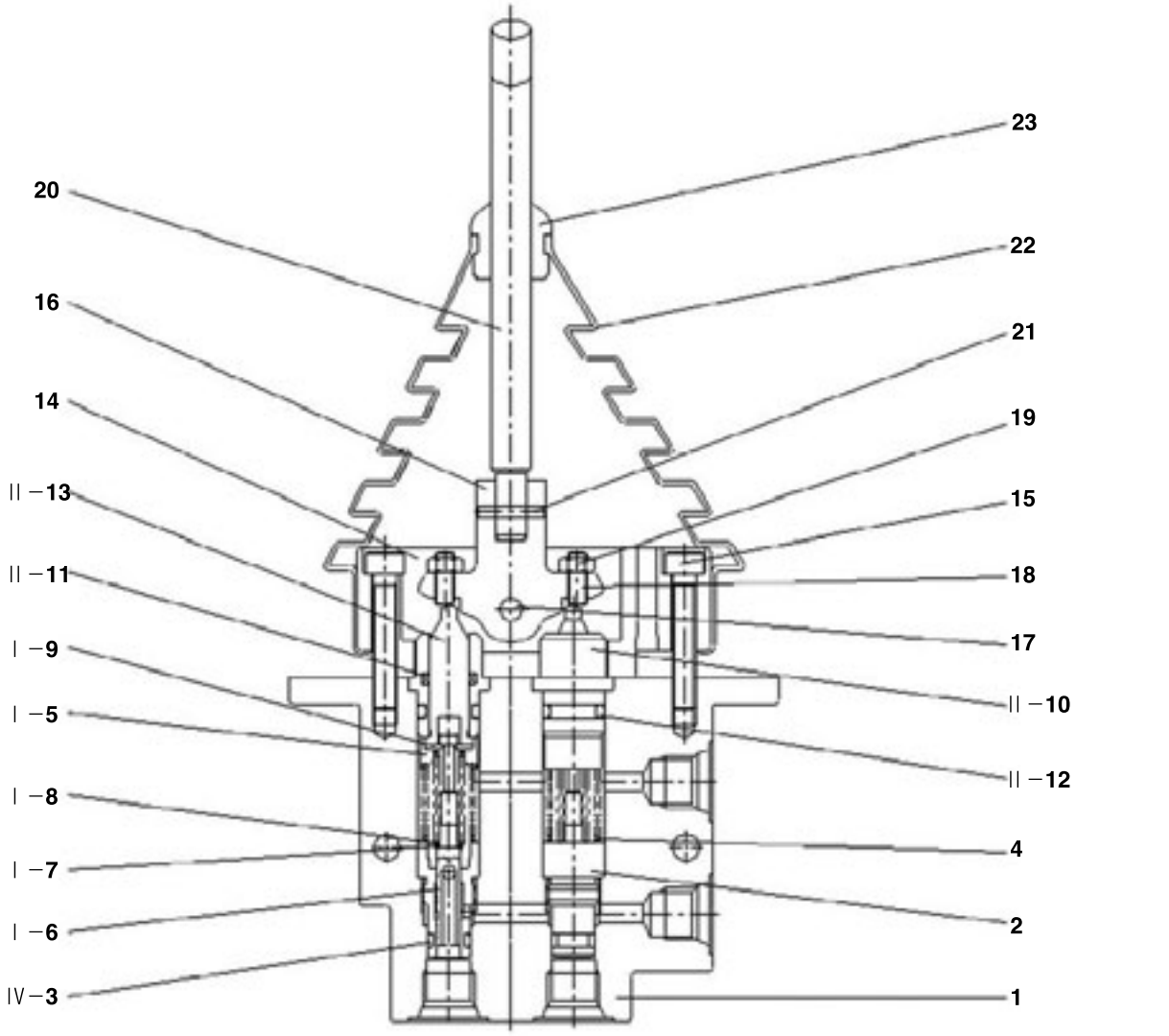


FG007444

Figure 2

No.	Part Name	Screw Spec	Assembly Torque (kg•cm)	Assembling Tools
1	Logic valve	M20 x 1.5	450 ± 50	Torque wrench/32mm Hex. socket
2	Relief valve	UNF7/8-14"	450 ± 50	Torque wrench/1" Hex. socket
3★3	Check Valve	UNF7/8-14"	450 ± 50	Torque wrench/1" Hex. socket
4	Unloading Valve	M20 x 1.5	450 ± 50	Torque wrench/32mm Hex. socket
5★3	PT 1/4" Plug	PT 1/4-19"	500	Torque wrench/6mm Wrench socket
6★6	PT 1/8" Plug bolt	PT 1/8-28"	280	Torque wrench/5mm Wrench socket
7★3	PF 1/4" Plug	PF 1/4-19"	250 ± 25	Torque wrench/19mm Hex.socket

STRUCTURE



FG003779

Figure 1

TOOLS

1. Holding tool + guide-ring
   Code no.: SJ 150-9000-2.
   Best.nr.: SJ 150-9000-16.

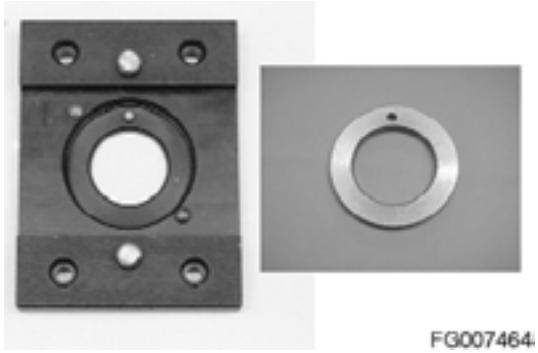


Figure 4

2. Assembly tool for O-ring and kin-ring / Roto Glyd
   Code no.: SJ 150-9000-11.
   Best.nr.: SJ 150N4014-1.

Figure 5

3. Assembly tool for lip seal.
   Code no. SJ 150-9000-17.

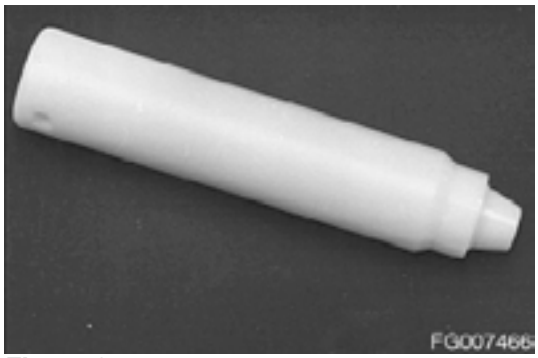


Figure 6

4. Assembly tool for cardan shaft.
   Code no. SJ 150-9000-3.

Figure 7

5. Assemble spool and sleeve.

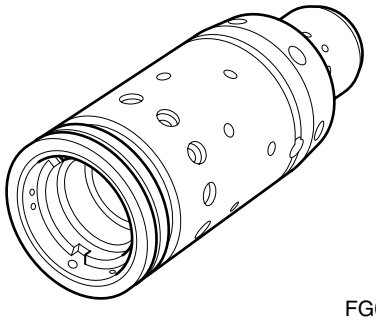
CAUTION!

OSPB LS, OSPBX LS, OSPC LS, OSPC LSR and OSPF

When assembling spool and sleeve only one of two possible ways of positioning the spring slots is correct.
There are three slots in the spool and three holes in the sleeve in the end of the spool/sleeve opposite to the end with spring slots. Place the slots and holes opposite each other so that parts of the holes in the sleeve are visible through the slots in the spool.

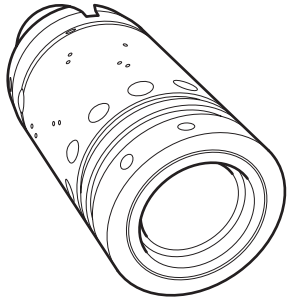
OSPB CN and OSPC CN

Assemble the spool/sleeve and make sure the marks on spool and sleeve are opposite each other (see drawing page 10).



FG003318

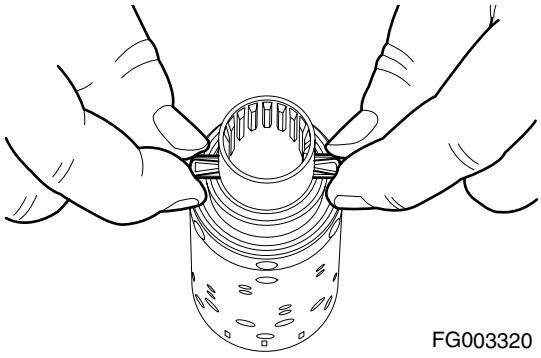
Figure 43



FG003319

Figure 44

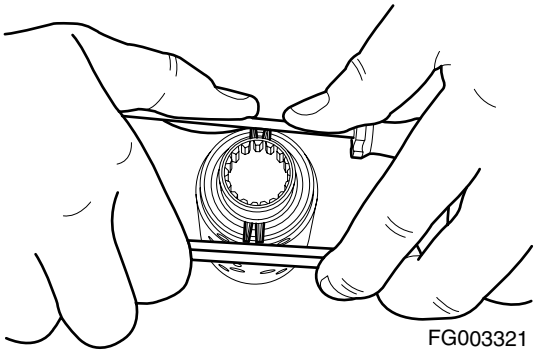
6. Press the springs together and push the neutral position springs into place in the sleeve.



FG003320

Figure 45

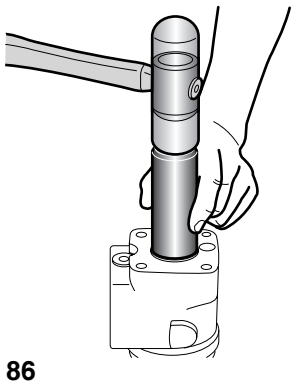
7. Line up the springs and center them.



FG003321

Figure 46

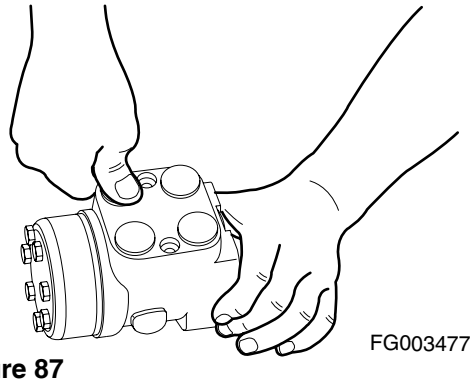
6. Fit the dust seal ring in the housing using special tool SJ 150-9000-22 and a plastic hammer.



FG003476

Figure 86

7. Press the plastic plugs into the connection ports. Do not use a hammer!

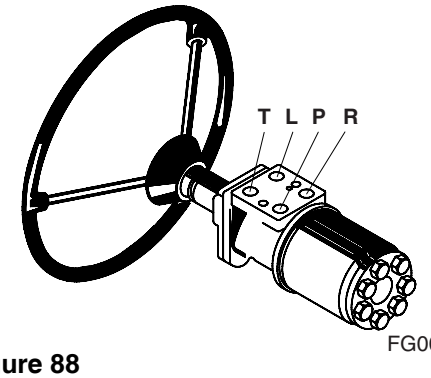


FG003477

Figure 87

Hydraulic Connections

Reference Number	Description
L	Left Port
R	Right Port
T	Tank
P	Pump

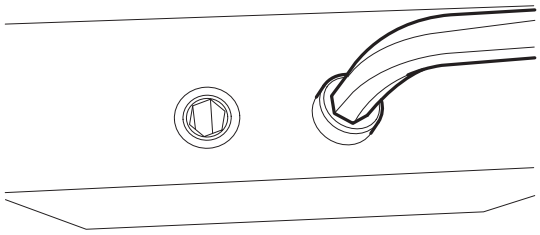


FG003478

Figure 88

ASSEMBLY

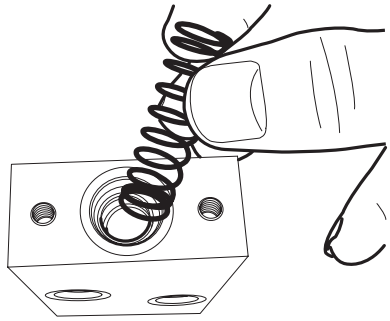
1. Assemble plug (2) in the body (1).



FG007513

Figure 8

2. Assemble spring (8) in the body (1).



FG007512

Figure 9

3. Assemble spool kit (I).

   Assemble spring seat (I-4), spring (I-5), spring seat (I-6) and stopper (I-7) at spool (I-3) in the order.

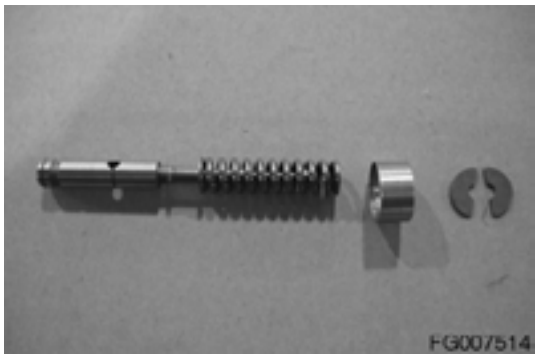
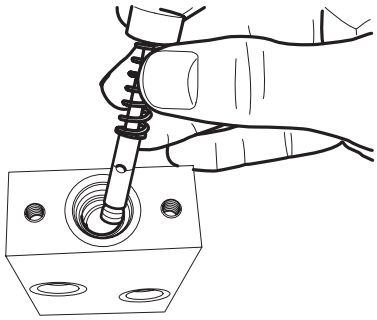


Figure 10

4. Assemble spool kit (I) in the body (1).



FG007511

Figure 11

DISASSEMBLY AND ASSEMBLY

General Cautions

It is the principle that disassembly and assembly of this valve should carried out by the manufacturer. In case disassembly and assembly is inevitably required elsewhere, the following cautions must be observed.

1. This valve is precisely processed and the gaps among each part are extremely tiny. This, disassembly and assembly should be performed very carefully so that any foreign material such as dust or sand can not intrude into the valve.
2. For disassembly, a technician should start disassembly after fully understanding the structure of the valve with structural drawings and reference drawings.
3. When the valve needs to be removed from a machine, be sure to put caps on each port and to wash the exterior of the assembly after checking the caps on each port again before assembling.
4. In case the disassembled parts need to be placed unassembled for a while, they must be treated with rust prevent oil and sealed to prevent rusting.
5. Do not hold a pilot cap, a relief valve and a overload relief valve when this valve needs to be moved.
6. Even in case disassembly and assembly is not peformed smoothly, do not hit or treat any part of the product roughly.
7. After disassembly, attach ID tags to each part for accurate assembly.
8. For O-rings and back up-rings, it is the principle to use the new ones. And be sure not to damage one during assembly. (Apply a small portion of grease on the parts for smooth assembly.)
9. Fasten bolts, overload relief valves and main relief valves with the specified standard torque.
10. As various tests (relief characteristics test, leakage test, operational test, etc.) are essential after disassembly and assembly, do not disassemble this valve if those tests are not available.
11. Be careful not to damage the O-ring contacting parts of this valve for preventing oil leakage.
12. Be cautious about safety during operation as this valve assembly is heavy.

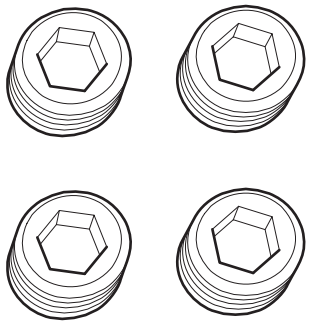
MEMO

CLEANING AND INSPECTION (WEAR LIMITS AND TOLERANCES)

For general cleaning and inspection procedures, refer to "General Maintenance Procedures" section.

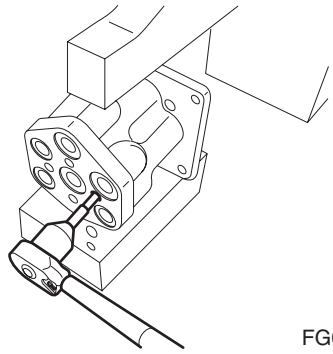
REASSEMBLY

1. Install four plugs (2) into case (1).



FG000815

Figure 17



FG000817

Figure 18

2. Install bushing (3) into case (1) using jig.

FG000814

Figure 19

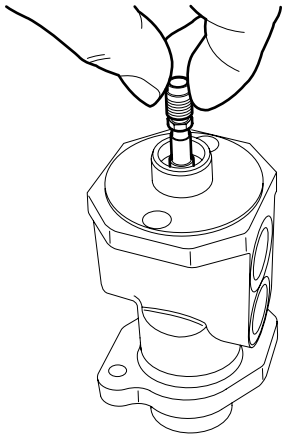
Table of Contents

Service Brake Pedal Valve

2. Insert spool into the lower part.

CAUTION!

Take care to prevent dust or foreign substances entering into valves after washing.



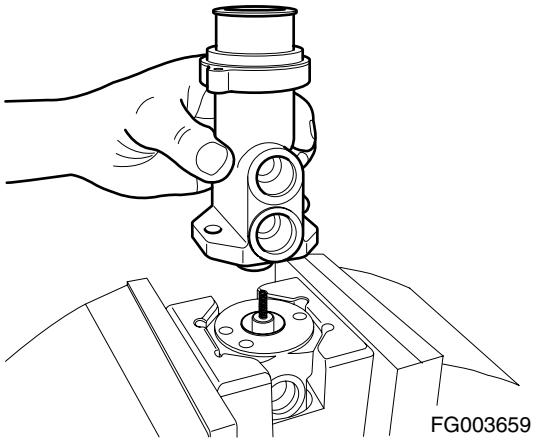
FG003658

Figure 12

3. Assemble the upper and lower parts.

CAUTION!

Do not forget to install O-ring.

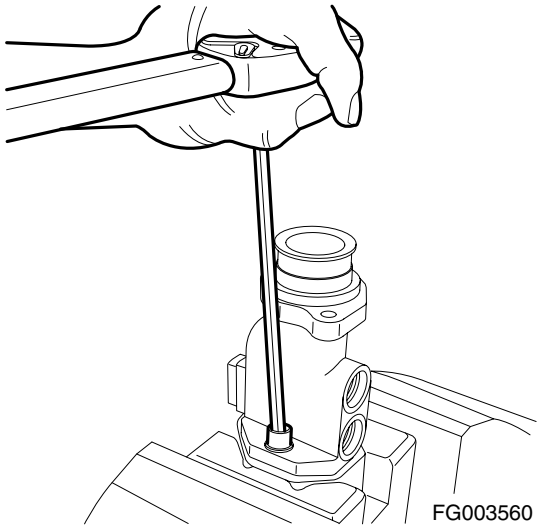


FG003659

Figure 13

4. Connection of the upper and lower parts

   6 mm torque wrench (Tightening torque: 250 ~ 300 kgf•m)



FG003560

Figure 14

Table of Contents

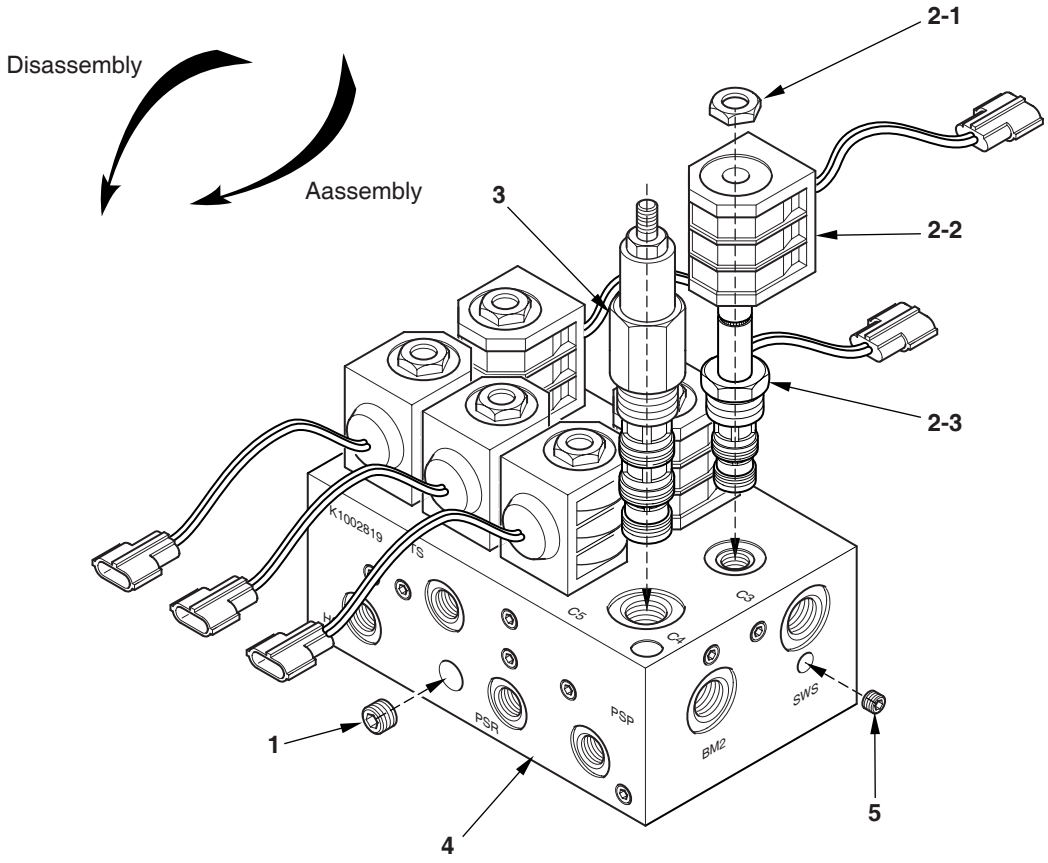
Solenoid Valve Assembly

Exploded View and Tools

The assembly torque of each part in the solenoid valve package is described in the table below.

Observe the specified torque values using the right tool.

Disassembly, Re-assembly of Solenoid Valve Package, and Necessary Tools



FG007536

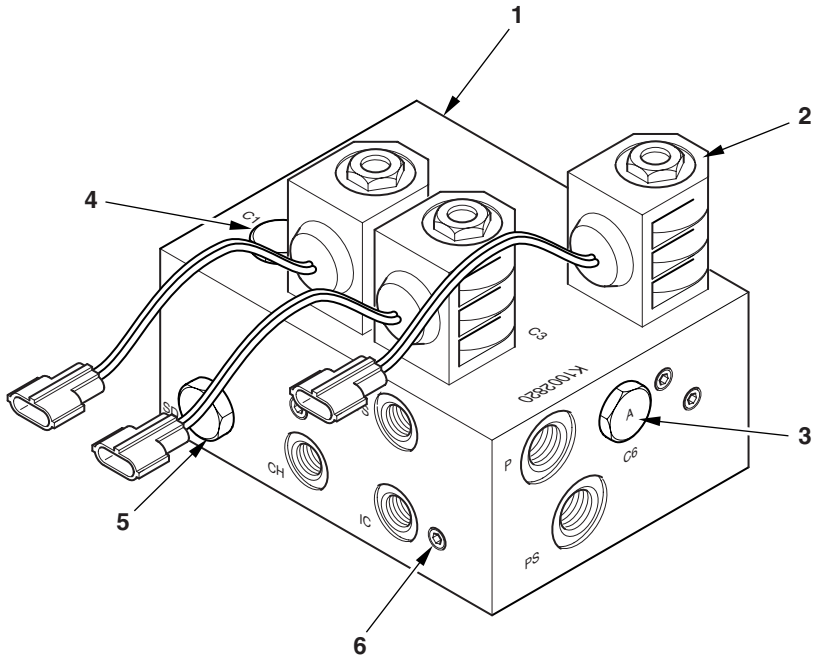
Figure 5

No.	Part Name	Screw Spec	Assembly Torque (kg•cm)	Assembling Tools
2-1	Coil Lock Nut	UNF1/2-20"	60 ± 2	Torque wrench/19mm hex. socket
2-3	Solenoid Valve	UNF7/8-14"	200 ± 25	Torque wrench/1" hex. socket
3	Pilot Shift Valve	UNF7/8-14"	200 ± 25	Torque wrench/1" hex. socket
4	PT 1/4" Plug Bolt	PT 1/4-19"	500	Torque wrench/6mm wrench socket
5	PT 1/8" Plug Bolt	PT 1/8-28"	280	Torque wrench/5mm wrench socket

3-SOLENOID

Diagram of 3-Solenoid Valve Assembly Package

3-Solenoid valve assembly package includes parts described in the table below.



FG000008

Figure 10

No.	Part Name	Part Specification	Quantity	Remark
1	Manifold Block	80*149*178	1	1-A2130-03-1
2	Solenoid Valve	TF-S3A-00-VDL24VDC	6	C2, C3, C4
3	Check Valve	FD-CDP-O-A	2	C5, C6
4	Dummy Plug	-	1	C1
5	Plug	PF1/4-19"	1	SD
6	Plug	PT1/8"	11	

ENGINE PREHEATING SYSTEM

An air heater (8) is installed in the intake manifold of the engine. When the starter switch (5) is turned "ON," the current flows from the battery (1) → fusible link (3) → fuse box (6) → "B" terminal of starter switch (5) → "BR" terminal of starter switch (5) → "1-39" terminal of engine controller (12), causing current to flow though "1-16" terminal of engine controller (12) → "C and D" terminals of preheat relay (7) → "1-04" terminals of engine controller (12) → ground.

This current flow causes the coil in preheat relay (7) to be activated, closing contacts.

When the contacts of the preheat relay (7) are closed, the heating coils of the air heating device (8) are heated by current flowing from the battery (1) → battery relay (2) → preheat relay (7) → air heater (8) → ground.

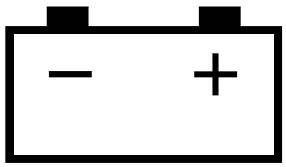
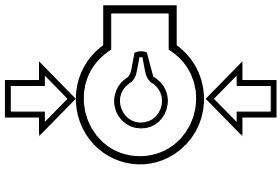
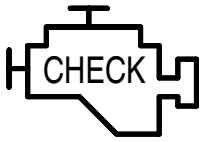
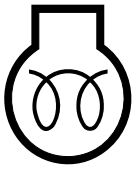
The duration of the heating cycle depends on the temperature of engine coolant. The preheat indicator light in the instrument panel (9) will turn "ON" during preheating cycle.

The preheat relay (7) is controlled by the engine controller (12) and operates only at temperatures of 10°C (50°F) and below.

The longer the preheating period, the lower the temperature of coolant is.

WARNING AND INDICATOR LIGHTS

Indication of Warning Lights

Description	Symbol	Input Terminal	Operation	Remarks
Charge	 HAOA610L	CN2 - 14	It lights in case of no charge [voltage of "R(I)" terminal is below 12 ± 1V] or overcharge [voltage of "R(I)" terminal is above 33(V)].	Normally, it lights when starting engine and is out after engine starts.
Engine Oil Pressure	 HAOA620L	ECU-CAN Communication	It lights when engine oil pressure is below the reference.	After starting engine, if engine oil pressure is insufficient after 8 seconds, a warning buzzer will sound.
Engine Check	 FG000045	ECU-CAN Communication	It lights in case of failure in engine system.	
Coolant Temperature	 HAOD350L	ECU-CAN Communication	It lights when engine coolant temperature sensor resistant is below the reference.	
Preheating	 HAOA639L	CN5-2	It lights during preheating ("CN5-2" terminal voltage is below 2V) and turns "OFF" after completion of preheating.	Preheating period depends on coolant temperature. No preheating at above 10°C 10 sec preheating at 5°C 20 sec preheating at below 0°C

SPECIAL MENU

In this menu, many types of operating conditions and functions can be accessed and displayed, including the e-EPOS controller. This menu is mainly used for machine testing and failure diagnostics.

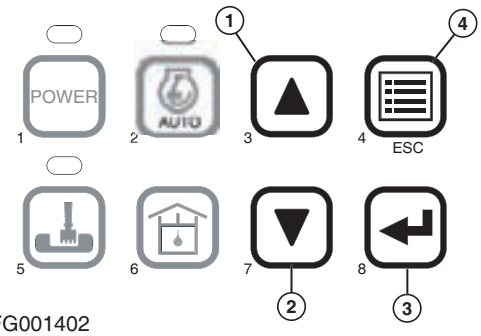
The special menu offers three sub-menus:

1. Machine status.
2. Failure information.
3. Information on machine operation.

Entering/Accessing and Exiting/Escaping Menus

Entering/Accessing Menus

When normal mode screen is displayed, if the enter button (↵, 3) and escape button (ESC, 4) are pressed simultaneously for more than 3 seconds, normal mode screen (Figure 25) will be changed to special menu screen (Figure 26).

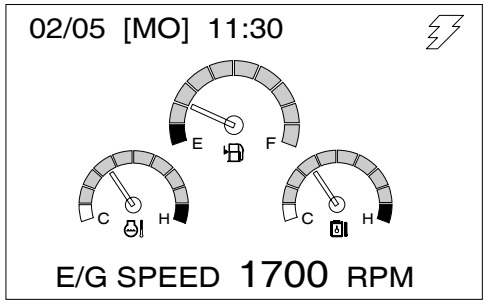


FG001402

Figure 24

Normal Mode Screen

NOTE: *Normal mode screen can display many kinds of display mode by selecting, for example, engine speed (RPM), battery voltage (VOLT), front pump pressure (BAR), rear pump pressure (BAR) and so on by selecting.*



FG000043

Figure 25

Code	Failure Component	Measuring Points	Current Valve		Remarks
			Active	Passive	
E044	Engine speed sensor		-	-	Synchronizing error between crank shaft speed sensor and cam shaft speed sensor.
E045	EEPROM		-	-	Data storing error when engine stop.
E046	Recovery		-	-	
E047	Monitoring of PRV		-	-	When the pressure sensor of common rail or high-pressure pump has a defect.
E048	Power supply	1-13 1-15	V = V_volt	-	
E049	Main relay SCB		-	-	
E051	Main relay ECU		-	-	
E058	Solenoid power stage 1	3-13 3-09	-	R=0.31 ±0.42 Ω (20°C (68°F))	
E059	Solenoid power stage 2	3-03 3-06	-	-	
E061	Solenoid power stage 3	3-04 3-12	-	-	
E062	Solenoid power stage 4	3-05 3-14	-	-	
E063	Solenoid power stage 5	3-11 3-16	-	-	
E064	Solenoid power stage 6	3-10 3-15	-	-	
E066	Preheat light (E/G: Lowside Power stage 2)	1-29 1-30	-	-	
E065	Fuel HI pressure pump (E/G: Current controlled Highside power stage 1)	-	-	-	Fuel metering unit error of high-pressure pump.
E068	Preheat relay (E/G: Highside Power stage 1)	1-16 1-04	V = V_volt	R=40 ±5 Ω (25°C (77°F))	Voltage is only measured when afterheat function is operating status.

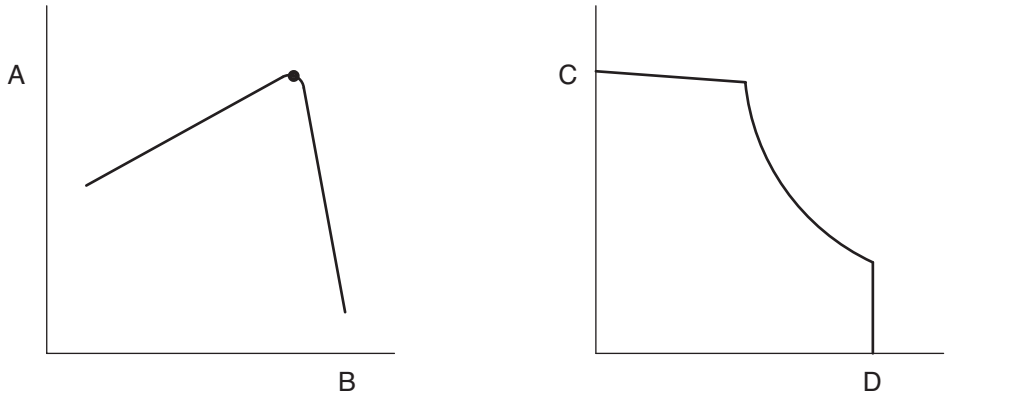


Figure 53

Reference Number	Description
A	Engine Horsepower (hp)
B	Engine Speed (rpm)
C	Pump Discharge Volume (lpm)

Reference Number	Description
D	Pump Discharge Pressure (kg/cm^2)